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# Relative needs index study, South Australia and New South Wales

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## **Editorial team**

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# Abbreviations

- DAS Dental Anxiety Scale
- NSW New South Wales
- OHIP Oral Health Impact Profile
- RNI Relative Needs Index
- ROC Receiver Operating Characteristic
- SA South Australia

# Symbols

- \* statistically significant
- n.s. not statistically significant
- .. not applicable

# Summary

The Relative Needs Index (RNI) Study applied indicators of patient-perceived treatment needs (i.e. symptom-based measures of disease, and social and psychological consequences of oral diseases and disorders) and compared them to a clinical judgment of urgency of care. The RNI study sought to determine the relative need of patients attending for emergency and general dental care by assessing both patient-perceived need and a clinical determination of need stratified into a hierarchy of urgency of care.

At present there are no criteria or protocols in place that can be used to check or assess the reasonableness of a patient's presentation for emergency dental care or even the relative need or priority of patients on the waiting list for general dental care.

Currently, waiting lists for general dental care are based on a chronological queuing of patients, meaning that general dental care is offered on a 'first come, first served' basis to potential patients in the order they entered the waiting list. However, is this the most egalitarian approach to rationing dental care?

It may seem equitable to take the approach of 'those who make the first claim to wanting to receive dental care by joining a waiting list should also be the first to receive the care'. However, there are clear disadvantages involved in the use of this system. It does not take into consideration a patient's need for care or the urgency with which the care is required.

One way of circumventing the problems associated with allocating dental care to patients on the basis of waiting time is to ration the care on the basis of their overall experience of oral diseases and disorders. Patients would be given priority on the waiting list depending on their reported symptoms and/or the psychosocial impact of their oral problem. Systems that give priority to patients with the greatest need first are deemed to be equitable, and should facilitate better access to adult dental care in both South Australia (SA) and New South Wales (NSW).

The data in the report derives from individual client experience of the problem presented to clinic, and is cross-matched with data provided by the assessing dentists. If client perception and dentist perception are assumed to express the pragmatic experience of access to care, the results suggest that some triaging of emergency and general patients using questions similar to the ones asked in the questionnaire may not be seen as unreasonable by both clients and service providers.

A total of 839 (91.2% of the anticipated sample) and 740 (82.2% of the anticipated sample) eligible patients requesting emergency dental care and general dental care were recruited across South Australia (SA) and New South Wales (NSW) respectively.

Subjective oral health status indicators (i.e. experience of pain or other oral symptoms) and the psychosocial impact of oral disorders were examined as potential predictors of urgency of care.

Psychosocial impact was assessed by asking patients if, during the last week for emergency patients or the last four weeks for general patients, they had experienced specific events because of problems with their teeth, mouth or dentures. The study included social impact questions on toothache and other oral and facial pain, being concerned/worried about one's dental health or appearance, avoidance of going out, ability to carry out daily activities and dental anxiety.

For the emergency sample, just over 71% of patients reported having a toothache in the last week, almost 70% indicated that they were worried about the appearance of their teeth or mouth, approximately 31% stayed home more than usual and 26.5% reported avoiding their usual leisure activities because of problems with their teeth, mouth or dentures. Variables having a statistically significant association with urgency of care included age, education, experience of toothache, pain in teeth with hot or cold food/fluids, pain in jaw while opening mouth wide, sore gums, bleeding gums, pain at night, difficulty sleeping, staying home more than usual, avoiding usual leisure activities and worry/concern about the health of one's teeth or mouth.

For those patients seeking general dental care, almost 45% reported having a toothache in the last four weeks, 41% of the sample indicated that they were prevented from eating foods they would like to eat, just over 49% felt uncomfortable eating any foods, almost 70% indicated that they were worried about the appearance of their teeth or mouth, approximately 44% reported being embarrassed by the appearance/health of their teeth or mouth and just over 27% felt that life in general was less satisfying. Variables having a statistically significant association with urgency of care included age, usual/previous occupation, experience of toothache and various other oral and facial pain symptoms, being prevented from eating certain foods, decreased enjoyment of food and being worried/concerned or embarrassed about the appearance and health of one's teeth or mouth.

Logistic regression was used to further examine the significant bivariate associations for each sample, and models were developed to aid in the prediction of urgency of care. Since the experience of symptoms reported by patients in each sample is somewhat different, the perceived treatment needs of emergency and general patients will also be different. These differences are accounted for by using separate models to predict urgency of care for each sample.

## **Emergency dental care**

Three statistical models were developed to predict the treatment urgency of patients attending for emergency dental care.

The first regression modelled 'urgency' as needing to be seen within 48 hours compared to more than 48 hours. Difficulty sleeping, pain in the jaw when opening mouth wide, having a broken filling, having a loose tooth and concern about the health of one's teeth or mouth had a significant positive association with needing to be seen within 48 hours. In addition, bleeding gums were negatively associated with needing to be seen within 48 hours.

The second model determined which factors were associated with needing to be seen in the period 2–7 days compared with more than 7 days. Factors significantly associated with needing to be seen in the period 2–7 days included experience of toothache, pain in teeth with hot food or fluids, bleeding gums, having a broken filling, difficulty sleeping all the time, and concern about the appearance of teeth or mouth. The third model determined the associations with needing to be seen within one week compared with 8 or more days. Those factors with a significant positive association with needing to be seen within a week were presence of toothache, having a broken filling, having a loose tooth, difficulty sleeping all the time and very often being concerned about appearance of teeth and mouth.

## General dental care

Two statistical models were developed to predict the treatment urgency of patients requesting general dental care.

The first regression modelled 'urgency' as needing to be seen within 6 months compared to 7 or more months. Factors significantly associated with needing to be seen within 6 months included oral and facial pain symptoms scale, oral health impact profile (OHIP) scale, usual reason for dental visit, time since last visit and smoking.

The second model determined which factors were associated with needing to be seen within 3 months compared with 4 or more months. Factors significantly associated with needing to be seen within 3 months included the oral and facial pain symptoms scale, oral health impact profile (OHIP) scale, usual reason for dental visit, place of last dental visit, usual/previous occupation, a lost filling, a loose tooth and being a smoker.

## Predictive ability of the models

Sensitivity, specificity, positive predictive values and negative predictive values were calculated for each model to determine how well the models were able to predict urgency of care. Sensitivity and specificity are dependent on the cut-off values selected for the test, i.e. the value above which the test is interpreted as urgent. The relationship between the cut-off value and sensitivity/specificity were examined for each model using receiver operating characteristic (ROC) curves. As the cut-off was modified (i.e. as the point that separated non-urgent patients from urgent patients was changed), the sensitivity and specificity of the test also changed; sensitivity was enhanced at the expense of specificity and vice versa. A sensitive test will have few false negative test results while a specific test will have few false positive test results. The decision to maximise either sensitivity or specificity depends on the relative cost of a false positive test result.

This study has indicated that there are tests that may prove useful in giving priority to patients seeking emergency and general dental thus making the RNI a potentially useful tool for allocating priority to patients. The application of RNI requires management decisions on the desirable clinical/political outcomes. The selected approach then needs to be demonstrated and the effects monitored.

# 1 Introduction

# 1.1 Background

The reduction in funding for adult public dental services as a result of the cessation of the Commonwealth Dental Health Program (CDHP) in 1997 has led to a substantial fall in the capacity of public dental services to provide dental care for eligible persons.

Public dental services are experiencing strong demand for 'emergency' care and eligible persons seeking 'general' care are placed on waiting lists for care which have a waiting period of up to 4 years.

At present there are no tested criteria by which:

- the reasonableness of the presentation for emergency dental care can be checked; or
- the relative need or priority of eligible persons on the waiting list for general dental care can be assessed.

The New South Wales Oral Health Branch and the South Australian Dental Service sought the development and testing of protocols that might be used by non-dental staff in determining the relative need of eligible persons presenting for either emergency or general dental care.

The conceptual framework for this project starts with a definition of health as 'an individual's subjective experience of his/her functional, social and psychological well-being' (Locker 1997). There has been increasing interest in the development of psychosocial measures of oral health and oral quality of life. A number of measures have been developed but these have not frequently been related to normative measures of oral health.

The Relative Needs Index (RNI) Study applied indicators of patient-perceived treatment needs (i.e. symptom-based measures of disease and social and psychological consequences of oral diseases and disorders) and compared them to clinical judgment of urgency of care in an endeavor to develop a foundation for an alternative strategy of client prioritisation.

Prioritisation of patients in a more timely and equitable manner was hypothesised to facilitate better access to adult dental care in South Australia (SA) and New South Wales (NSW). The RNI study attempted to determine the relative need of patients attending for emergency and general dental care by assessing both patient perceived need and a clinical determination of need stratified into a hierarchy of urgency of care.

## 1.2 Purpose

Due to the increasing demands placed on public dental services, the primary objectives of the RNI study were to develop and test criteria for the provision of emergency and general dental care within the public dental system.

The specific aims were to develop and test:

- the usefulness of a series of criteria for eligibility for emergency dental care; and
- a subjective index of relative dental need for general dental care within public-funded dental programs.

The study was a prospective study examining associations between subjective indicators and clinical judgment of urgency.

## 1.3 Methodology

### Sample selection

A random sample of eligible adults presenting to public dental clinics in NSW and SA for emergency and general dental care was used. Participants were informed of the study at the time they contacted the clinic for dental care. The criteria used to select emergency and general dental care patients for the study are shown in Table 1.

Selection criteria	Emergency sample	General sample
Aged 18 years or more	1	√
Dentate with 6 or more teeth	✓	✓
Holder of a current government concession card	1	✓
New to waiting list	_	✓
Have not visited a dentist (private or public) for routine dental care in the last 12 months $^{\!\!(a)}$	_	✓

 Table 1: Sample selection

(a) Patients who received emergency dental care in the last 12 months were included provided they were not already on the waiting list for routine dental care.

Emergency care patients were asked to participate prior to their attendance at the clinic. General dental care patients were asked to participate at the time that they were placed on the waiting list. A benefit of participating for general dental care patients was a shorter waiting time, e.g. 1 month. In each instance verbal consent to participate in the study was initially obtained. Written consent was sought when the patient attended the clinic for their appointment.

Participants completed a structured interview on subjective indicators and were then tracked through examination, diagnosis and treatment planning, and the provision of treatment within public dental clinics in NSW and SA. The positive consent form signed by participants gave authorisation to the researchers to access the data captured as part of their clinical care and link it to the information collected from the structured interview. Associations between self-reported indicators and oral health status, normative needs and clinical judgment of risk could therefore be assessed.

## Sample sizes

The sample sizes required from selected public dental clinics across SA and NSW for both the emergency and general samples are shown in Table 2.

Sample	State	Public dental clinic	Ν
Emergency	SA	Adelaide Dental Hospital – GDU	125
		Lyell McEwin	125
		Noarlunga	125
		Port Adelaide	125
		SA emergency sample total	500
	NSW	United Dental Hospital	80
		Western Sydney Area Health Service – Mt Druitt	70
		Illawarra Area Health Service – Bulli	70
		South Western Sydney Area Health Service – Narellan	50
		Mid North Coast Area Health Service – Coffs Harbour	150
		NSW Emergency sample total	420
General	SA	East Marden	80
		Gawler	60
		Gilles Plains	130
		Kadina	30
		Parks	90
		Somerton Park	100
		Victor Harbour	60
		SA general sample total	550
	NSW	United Dental Hospital	120
		Western Sydney Area Health Service – Mt Druitt	70
		Illawarra Area Health Service – Bulli	70
		South Western Sydney Area Health Service – Narellan	90
		NSW general sample total	350

Table 2: Sample size required from selected dental clinics in SA and NSW

### **Data collection**

Participants were informed of the study at the time they contacted the clinic for either emergency or general dental care.

Emergency care patients were asked to participate prior to their attendance at the clinic. General dental care patients were asked to participate at the time that they were placed on the waiting list. A benefit of participating for general dental care patients was shorter waiting time, e.g. 1 month. In each instance verbal consent to participate in the study was initially obtained when the patient telephoned the clinic to make an appointment. Written consent was sought when the patient attended the clinic for their appointment.

A questionnaire containing subjective oral health status indicators was administered to consenting patients by non-dentist clinic staff. Following the questionnaire, the patient underwent an oral health assessment performed by one of the clinic dentists. Information relating to the patient's oral health status was recorded in order to obtain epidemiological data for the study. The assessing dentist also completed a proposed treatment plan for the patient. A second dentist then provided the patient with appropriate treatment (treatment needs were assessed independently of the assessing dentist) and assessed the patient's risk of future disease. The treatment provided and the future oral risk status of the patient were recorded. In addition, each dentist was asked to judge and record the urgency of the patient's oral health needs.

The positive consent form signed by participants gave authorisation to the researchers to access the data captured as part of their clinical care and link it to the information collected from the structured interview. Associations between self-reported indicators and oral health status, normative needs and clinical judgment of risk and urgency of care could therefore be assessed.

### Data items

- 1. The information collected from the administered questionnaire related to:
  - sociodemographic characteristics e.g. patient's sex, age, country of birth, indigenous status, language mainly spoken at home, ethnicity, level of education, concession card status
  - subjective oral health indicators e.g. oral and facial pain symptoms, social and psychological impact of oral disorders
  - dental visiting factors e.g. usual reason for visiting the dentist, time since last visit, site of last visit, frequency of visiting the dentist
- 2. Information collected at the oral health assessment related to:
  - oral health status e.g. teeth present, coronal and root caries experience, periodontal disease status, the presence and condition of prostheses, oral mucosal conditions
  - diagnoses and proposed treatment needs including urgency
  - clinical judgments on the risk of further oral disease
- 3. Information collected at the treatment phase related to:
  - treatment and service provided
  - urgency of care
  - clinical judgment on the oral health outcome at the completion of a course of care in terms of the risk of further oral disease, likelihood of compliance with preventive advice, and expectations for future maintenance course of care.

# 2 Emergency dental care

## 2.1 Participants

Of the 920 participants required for the emergency component of the RNI Study, 839 patients requesting emergency care were recruited across SA and NSW. Overall, 91.2% of the anticipated sample was collected. A breakdown of the sample collected at each clinic in each state is given in Table 3.

In SA 429 eligible patients requesting emergency care were randomly recruited for the study. Overall, 85.4% of the required sample for SA was collected. In NSW 412 patients were selected for inclusion in the study, making up 98.1% of the required sample for that state.

State	Community Dental Service Clinic	Anticipated sample size	Sample size achieved	
SA	Adelaide Dental Hospital – GDU	125	76	
	Lyell McEwin	125	85	
	Noarlunga	125	134	
	Port Adelaide	125	132	
	SA total	500	427	(85.4%)
NSW	United Dental Hospital	80	79	
	Western Sydney Area Health Service – Mt Druitt	70	71	
	Illawarra Area Health Service – Bulli	70	70	
	South Western Sydney Area Health Service – Narellan	50	42	
	Mid North Coast Area Health Service – Coffs Harbour	150	150	
	NSW total	420	412	(98.1%)
	Total sample	920	839	(91.2%)

Table 3:	Sample size	collected from	selected dent	tal clinics in	SA and NSW
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## 2.2 Population characteristics

### Sociodemographic characteristics of respondents

The percentages of respondents in each of several sociodemographic groupings for both SA and NSW, as well as in the overall sample are shown in Table 4.

There is an over-representation of females in the sample, which is possibly due to higher reputed usage of dental services by women.

By age, the largest proportion of patients were in the 24–44 years age group (almost 40%), while the smallest proportion of patients (8.5%) were in the youngest age group category (18–24 years), which spanned only 7 years.

Almost two-thirds of the respondents were born in Australia. There were very few Aboriginals or Torres Strait Islanders in the emergency component of the RNI study.

The majority of respondents had completed some or all of their secondary school education (62.3%); 42.9% had some secondary school education while a further 19.4% had completed secondary school.

Just over 60% of patients presenting for emergency dental care held a full-entitlement pensioner concession card and over one-third of the respondents had a health care card.

	SA	NSW	Total
	(n = 427)	(n = 412)	(n = 839)
	%	%	%
Sex of patient	n = 427	n = 412	n = 839
Male	43.3	42.7	43.0
Female	56.7	57.3	57.0
Age group	n = 425	n = 410	n = 835
18–24 years	7.1	10.0	8.5
25–44 years	37.4	42.2	39.8
45–64 years	32.5	25.1	28.9
65+ years	23.1	22.7	22.9
Born in Australia	n = 426	n = 412	n = 838
Yes	65.0	64.3	64.7
No	35.0	35.7	35.3
Language mainly spoken at home	n = 426	n = 412	n = 838
English	93.4	85.9	89.7
Other	6.6	14.1	10.3
Indigenous status	n = 426	n = 412	n = 838
No	98.1	97.8	98.0
Yes, Aboriginal	1.6	1.9	1.8
Yes, Torres Strait Islander	0.2	0.2	0.2
Highest level of education	n = 426	n = 409	n = 835
Primary school	8.2	10.8	9.5
Some secondary school	46.9	38.6	42.9
Completed secondary school	16.4	22.5	19.4
Some university or higher education	4.9	4.4	4.7
Completed university or higher education	5.2	3.4	4.3
Some TAFE, CAE or vocational course	5.4	4.4	4.9
Completed TAFE, CAE or vocational course	10.6	15.9	13.2
Other	2.3	-	1.2
Health care card status	n = 427	n = 412	n = 839
Pensioner Concession Card (full) only	62.3	60.4	61.4
Pensioner Concession Card (part) only	1.9	3.2	2.5
Health Care Card only	34.4	35.0	34.7
Veterans Affairs Card only	0.7	0.5	0.6
Commonwealth Seniors Card only	-	0.2	0.1
Other eligible combinations	0.7	0.7	0.7

#### Table 4: Distribution of sample sociodemographic characteristics by state

### Access to dental services

Dental visiting patterns of respondents in both SA and NSW, and in the overall samples, are shown in Table 5.

Almost 50% of respondents had visited a dentist in the last 12 months and just over 85% of all respondents reported that a dental problem or pain was their usual reason for a dental visit. The majority of respondents (73.3%) had received their last course of care at a public hospital or clinic. Almost 30% of respondents indicated that they would usually go to the dentist once every 2 years.

	SA	NSW	Total
	(n = 427)	(n = 412)	(n = 839)
	%	%	%
Private dental insurance	n = 427	n = 412	n = 839
Yes	4.0	1.0	2.5
No	96.0	99.0	97.5
Usual reason for visit	n = 427	n = 410	n = 837
Check-up	17.1	9.8	13.5
Problem/pain	81.3	89.3	85.2
Check-up/problem/pain	1.6	1.0	1.3
Time since last visit	n = 427	n = 412	n = 839
<12 months	50.1	44.9	47.6
12-<2 years	18.7	20.6	19.7
2–<3 years	10.1	13.8	11.9
3–<5 years	9.1	8.3	8.7
5+ years	11.9	11.7	11.8
Never	-	0.7	0.4
Place of last visit	n = 426	n = 410	n = 836
Private practice	21.1	23.2	22.1
Public hospital/clinic	73.0	73.7	73.3
School Dental Service	4.0	1.7	2.9
Other	1.9	1.5	1.7
Frequency of dental visits	n = 426	n = 405	n = 831
More than 2 times a year	8.2	8.1	8.2
2 times a year	8.0	7.2	7.6
Once a year	24.6	23.0	23.8
Once every 2 years	30.0	26.7	28.4
Once every 5 years	11.7	13.3	12.5
Less often than that	17.4	21.7	19.5

#### Table 5: Dental visiting factors by state

## 2.3 Data variables

### **Dependent variable**

The aim of this study was to determine levels of priority of those people seeking emergency dental care. Urgency of care, based on the assessing dentist's clinical judgment, was therefore used as the dependent variable. This variable consists of the following four categories into which a patient's urgency for dental treatment may be classified by the assessing dentist: 48 hours, 2–7 days, 8–13 days, 14+ days.

### Independent variables

Questionnaire variables were developed from the literature to reflect potential predictors of urgency of care. These variables are described in Table 6.

Sociodemographic variables	• age group
	sex of patient
	born in Australia
	language mainly spoken at nome     movimum education
	• maximum education
Oral and facial pain symptoms <sup>(a)</sup>	In the last week have you had the following problems?
	toothache
	pain in teeth with hot food or fluids
	<ul> <li>pain in teeth with cold food or fluids</li> </ul>
	pain in teeth with sweet food
	pain in jaw while chewing
	pain in jaw when opening mouth wide
	pain in front of ear
	<ul> <li>burning sensation in tongue or other parts of mouth</li> </ul>
	shooting pain in face or cheeks
	pain or discomfort from denture
	Response format: yes/no
Other oral symptoms <sup>(a)</sup>	In the last week have you had the following problems?
	mouth ulcers
	cold sores
	sore gums
	bleeding gums
	bad breath
	dryness of mouth
	unpleasant taste
	changes in ability to taste
	<ul> <li>clicking/grating noise in jaw joint</li> </ul>
	difficulty opening mouth wide
	Response format: yes/no

Table 6: Potential predictors of urgency of dental care

(a) The variables described in 'Oral and facial pain symptoms', 'Other oral symptoms', 'Activities of daily living impact (continued) scale' and 'Worry/concern impact scale' are taken from Locker's battery of eight Subjective Oral Health Status Indicators (SOHSI) (Locker, 1997). Only these four sets of subjective indicators have been used for the emergency component of the RNI Study.

(b) The Dental Anxiety Scale (Corah, 1969).

Activities of daily living impact scale <sup>(a)</sup>	<ul> <li>During the last week how often have pain discomfort or other problems with your teeth, mouth or dentures caused you to</li> <li>have difficulty sleeping?</li> <li>stay home more than usual?</li> <li>stay in bed more than usual?</li> <li>take time off work?</li> <li>be unable to do household chores?</li> <li>avoid usual leisure activities?</li> <li>Response format: all the time, very often, fairly often, sometimes, never</li> </ul>
Worry/concern impact scale <sup>(a)</sup>	<ul><li>During the last week how often have you worried about</li><li>the appearance of your teeth or mouth?</li><li>the health of your teeth or mouth?</li></ul>
	Response format: all the time, very often, fairly often, sometimes, never
Other symptoms	In the last week have you had the following problems? <ul> <li>pain which is worse in the middle of the day</li> <li>pain at night</li> <li>swelling on gums</li> <li>swelling of your face or neck</li> <li>a lost filling</li> <li>a lost crown</li> <li>a broken filling</li> <li>a broken crown</li> <li>a loose tooth</li> <li>a cracked tooth</li> <li>high temperature</li> </ul> Response format: yes/no
Other questions	Do you take any regular medication?
	<ul> <li>Have you experienced pain as a result of problems with your teeth, mouth or dentures?</li> </ul>
	Response format: yes/no
Dental anxiety <sup>(b)</sup>	<ul> <li>Imagine you had an appointment to go to the dentist tomorrow, how would you feel about it?</li> </ul>
	<ul> <li>Imagine you are waiting in the dentist's waiting room for your turn in the chair, how would you feel?</li> </ul>
	<ul> <li>Imagine you are in the chair waiting while the dentist gets the drill ready to begin working on your teeth, how would you feel?</li> <li>Imagine you are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist is getting out the instruments to be used to scrape your teeth around the gums, how would you feel?</li> </ul>
	Response format: responses scored from 1 to 5

#### Table 6: Potential predictors of urgency of dental care (continued)

(a) The variables described in 'Oral and facial pain symptoms', 'Other oral symptoms', 'Activities of daily living impact scale' and 'Worry/concern impact scale' are taken from Locker's battery of eight Subjective Oral Health Status Indicators (SOHSI) (Locker, 1997). Only these four sets of subjective indicators have been used for the emergency component of the RNI Study.

(b) The Dental Anxiety Scale (Corah, 1969).

# Distribution of responses to dependent and independent variables

#### Dependent variable distribution – urgency of care

The percentage of respondents falling into each category of urgency of care, as determined by the assessing dentist, by state and total sample is shown in Table 7.

	SA	NSW	Total
Urgency of care	(n = 395)	(n = 396)	(n = 791)
<48 hours	36.7	34.8	35.8
2–7 days	26. 8	42.7	34.8
8–13 days	10.4	9.8	10.1
14+ days	26.1	12.6	19.3

 Table 7: Percentage of respondents placed in categories of urgency of care

According to the assessing dentist, almost 36% of respondents required emergency care within 48 hours and a further 35% needed to be seen between 2 and 7 days.

#### Frequency of responses to independent variables

The percentage of respondents reporting 'yes' to various symptoms by state and overall sample is shown in Table 8. Patients were questioned about various problems they may have experienced in the last week.

Table 8:	Frequency	of res	ponses
----------	-----------	--------	--------

	SA	NSW	Total	
	Per cent within state	Per cent within state	Per cent within state	Sig.
Oral and facial pain symptoms				
Toothache	61.9	80.9	71.2	*
Pain in teeth with cold food or fluids	56.7	67.5	62.0	*
Pain in teeth with hot food or fluids	43.2	55.7	49.3	*
Pain in jaw while chewing	32.8	42.8	37.7	*
Pain in teeth with sweet food	28.9	41.3	35.0	*
Pain in front of ear	20.6	34.8	27.5	*
Shooting pain in face or cheeks	20.3	30.2	25.1	*
Pain in jaw when opening mouth wide	18.4	23.2	20.7	n.s.
Burning sensation in tongue or other parts of mouth	8.5	8.9	8.7	n.s.
Pain or discomfort from denture	5.6	7.8	6.7	*
Other oral symptoms				
Dryness of mouth	31.1	41.1	36.0	*
Sore gums	27.5	38.1	32.7	*
Unpleasant taste	25.9	44.3	34.9	*
Bleeding gums	25.4	31.1	28.2	*
Bad breath	24.7	39.3	31.9	*
Difficulty opening mouth wide	18.4	23.2	20.7	n.s.
Clicking/grating noise in jaw joint	11.8	18.9	15.3	*
Changes in ability to taste	10.4	18.3	14.3	*
Mouth ulcers	9.4	9.5	9.5	n.s.
Cold sores	7.1	5.1	6.1	n.s.

\* Statistically significant chi-square, P<0.05

n.s. Not statistically significant

(continued)

#### Table 8: Frequency of responses (continued)

	SA	NSW	Total	
	Per cent within state	Per cent within state	Per cent within state	Sig.
Activities of daily living impact scale				
Have difficulty sleeping	44.7	65.3	54.8	*
Stay home more than usual	23.4	38.6	30.9	*
Avoid usual leisure activities	21.1	32.0	26.5	*
Be unable to do household chores	12.6	25.5	19.0	*
Stay in bed more than usual	10.3	25.0	17.5	*
Take time off work	2.4	3.2	2.8	n.s.
Worry/concern impact scale				
Worry about health of teeth or mouth	84.5	88.7	86.6	*
Worry about appearance of teeth or mouth	64.6	75.2	69.8	*
Other symptoms				
Pain at night	35.4	53.3	44.1	*
A lost filling	28.6	32.4	30.4	n.s.
A cracked tooth	24.2	30.5	27.3	*
A broken filling	24.1	22.1	23.2	n.s.
Swelling on gums	19.5	27.7	23.6	*
A loose tooth	11.7	14.6	13.2	n.s.
Swelling of your face or neck	11.3	17.3	14.3	*
Pain which is worse in the middle of the day	8.5	20.2	14.2	*
High temperature	7.5	13.9	10.7	*
A broken crown	2.8	5.8	4.3	*
A lost crown	2.1	2.4	2.3	n.s.
Other questions				
Experienced pain	70.7	84.2	77.4	*
Taking any regular medication	51.1	49.5	50.3	n.s.
Dental Anxiety Scale (DAS) score				
DAS score ≥13	17.6	25.5	21.5	*
DAS score <13	82.4	74.5	78.5	

\* Statistically significant chi-square, P<0.05

n.s. Not statistically significant

As can be seen from Table 8, 77.4% of patients requesting emergency dental care across both states experienced pain in the last week.

Overall, 71.2% said 'yes' to experiencing a toothache, 62.0% said they experienced pain in their teeth with cold food or fluids, and almost 50% said they experienced pain with hot food or fluids. Other problems occurring with high frequency included pain at night (44.1%), pain in jaw while chewing (37.7%), dryness of mouth (36.0%) and pain in teeth with sweet food (35%).

Over 50% of the sample reported difficulty sleeping and almost 31% stayed home more than usual because of problems with their teeth, mouth or dentures. Almost 27% of the sample reported avoiding their usual leisure activities because of pain or discomfort associated with a dental problem.

The Dental Anxiety Scale (DAS) consists of four items. The respondent is asked to indicate on a 5-point scale how the statement makes them feel. The scale is scored by summing the responses to obtain a score between 4 and 20. A minimum score of 4 indicates no dental anxiety and a maximum score of 20 indicates that the patient is dentally phobic. The majority of patients (78.5%) had DAS scores of less than 13, indicating they were not anxious about visiting the dentist or receiving dental treatment.

## 2.4 Analyses

### **Bivariate analyses**

An initial analysis of the data was carried out to determine if any of the potential predictor variables (see section 2.3) should be considered for use in a multivariate model. Bivariate associations between the potential predictor variables and urgency of care were therefore examined. The results are displayed in Table 9.

		(Pe	Urge er cent with	ncy of care nin urgency	of care)			
	—	<48	2–7	8–13	14+			
Symptom	Response	hours	days	days	days	Total		Sig.
Oral and facial pain symptoms								
Toothache	Yes	79.9	82.1	61.5	45.7	72.3	0.000	*
Pain in teeth with hot food or fluids	Yes	51.2	58.3	47.4	30.0	49.2	0.000	*
Pain in teeth with cold food or fluids	Yes	61.9	70.2	62.8	49.3	62.5	0.000	*
Pain in teeth with sweet food	Yes	38.6	38.5	29.5	20.7	34.2	0.001	*
Pain in jaw while chewing	Yes	49.5	41.1	16.9	23.8	38.4	0.000	*
Pain in jaw when opening mouth wide	Yes	32.5	17.0	10.3	10.6	20.7	0.000	*
Pain in front of ear	Yes	37.2	26.7	23.4	15.2	27.9	0.000	*
Burning sensation in tongue/mouth	Yes	10.2	8.9	5.2	6.7	8.6	0.414	n.s.
Shooting pain in face or cheeks	Yes	35.1	26.7	18.2	9.3	25.5	0.000	*
Pain or discomfort from denture	Yes	6.0	6.9	7.5	6.6	6.6	0.383	n.s.
Other oral symptoms								
Mouth ulcers	Yes	9.9	10.6	11.4	7.3	9.8	0.678	n.s.
Cold sores	Yes	7.8	4.8	7.6	5.3	6.2	0.445	n.s.
Sore gums	Yes	37.9	32.6	19.0	31.6	33.0	0.016	*
Bleeding gums	Yes	27.3	34.5	18.8	24.5	28.4	0.018	*
Bad breath	Yes	34.4	37.1	23.8	21.3	31.8	0.002	*
Dryness of mouth	Yes	37.2	37.8	31.3	31.8	35.8	0.472	n.s.
Unpleasant taste	Yes	41.5	38.5	22.5	23.8	35.2	0.000	*
Changes in ability to taste	Yes	18.9	15.3	8.8	7.9	14.5	0.008	*
Difficulty opening mouth wide	Yes	32.5	17.0	10.3	10.6	20.7	0.000	*
Clicking/grating noise in jaw joint	Yes	17.7	14.5	10.0	14.6	15.2	0.360	n.s.

\* Statistically significant chi-square, P<0.05

n.s. Not statistically significant

(continued)

#### Table 9: Bivariate associations between independent variables and urgency of care (continued)

		(Pe	Urge er cent with	ncy of car hin urgenc	e y of care)	)		
Symptom	Response	<48 hours	2–7 davs	8–13 davs	14+ davs	Total		Sia.
Activities of daily living impac	tscale			aaje	uuje			3-
Have difficulty sleeping	All the time	29.0	15.3	75	46	17.3	0 000	*
have amounty sleeping	Verv often	12.0	9.1	5.0	2.0	8.5	0.000	
	Often	6.0	13.8	6.3	5.2	8.6		
	Sometimes	22.6	21.1	26.3	16.3	21.2		
	Never	30.0	40.7	55.0	71.9	44.4		
Stay home more than usual	All the time	12.4	8.7	3.8	0.7	8.0	0.000	*
	Verv often	7.8	6.5	3.8	1.3	5.7	0.000	
	Often	8.1	5.8	3.8	4.6	6.2		
	Sometimes	12.7	12.0	11.3	6.5	11.1		
	Never	59.0	66.9	77.5	86.9	69.0		
Stav in bed more than usual	All the time	3.9	2.5	1.3	0.7	2.5	0.001	*
	Verv often	5.7	5.1	5.0	_	4.3	0.001	
	Often	5.3	2.2	2.5	2.0	3.3		
	Sometimes	11.0	8.4	7.5	2.0	8.0		
	Never	74.2	81.8	83.8	95.4	81.9		
Take time off work <sup>(a)</sup>	All the time	2.1	0.4	_	_	0.9	0.071	**
	Verv often	0.4	1.5	_	_	0.6		
	Often	_	_	_	_	_		
	Sometimes	1.1	1.9	3.8	_	1.4		
	Never	96.4	96.3	96.3	100.0	97.1		
Be unable to do household	All the time	5.3	2.5	1.3	0.7	3.0	0.000	*
chores	Very often	6.7	2.5	1.3	0.7	3.5		
	Often	2.8	4.0	1.3	_	2.5		
	Sometimes	11.3	10.9	7.5	5.2	9.6		
	Never	73.9	80.0	88.8	93.5	81.3		
Avoid usual leisure activities	All the time	11.7	7.3	2.5	2.6	7.5	0.000	*
	Very often	4.9	3.6	2.5	0.7	3.4		
	Often	6.0	5.5	2.5	1.3	4.6		
	Sometimes	12.0	13.1	17.5	2.0	11.0		
	Never	65.4	70.5	75.0	93.5	73.6		
Worry/concern impact scale <sup>(a)</sup>								
Worry about appearance of	All the time	31.4	34.3	32.5	24.2	31.1	0.047	*
teeth or mouth <sup>(a)</sup>	Very often	9.9	8.4	18.8	9.8	10.3		
	Often	9.9	10.6	8.8	6.5	9.4		
	Sometimes	21.6	16.1	18.8	20.3	19.1		
	Never	27.2	30.7	21.3	39.2	30.1		
Worry about health of teeth	All the time	35.1	43.6	33.8	28.8	36.7	0.010	*
or mouth	Very often	20.8	12.1	18.8	15.0	16.4		
	Often	12.5	16.5	10.0	13.1	13.8		
	Sometimes	19.4	17.2	23.8	22.2	19.6		
	Never	12.2	10.6	13.8	20.9	13.5		

\* Statistically significant chi-square, P<0.05 (d</li>
 \*\* Statistically significant Spearman's rho (ordinal-ordinal variables)
 n.s. Not statistically significant
 (a) In the initial selection, a critical P-value of 0.25 was used to avoid rejecting potentially significant variables at this stage.

(continued)

		Urgency of care (Per cent within urgency of care)						
	-	<48	2–7	8–13	14+			
Symptom	Response	hours	days	days	days	Total		Sig
Other symptoms								
Pain worse in the middle of								
the day	Yes	19.4	16.6	9.1	4.6	14.6	0.000	*
Pain at night	Yes	57.6	49.1	35.1	20.5	45.3	0.000	*
Swelling on gums	Yes	32.6	23.3	7.5	16.6	23.7	0.000	*
Swelling of face or neck	Yes	24.5	12.8	6.3	5.3	14.9	0.000	n.s.
A lost filling <sup>(a)</sup>	Yes	26.6	32.7	38.8	28.1	30.3	0.130	*
A lost crown	Yes	3.2	0.7	1.3	4.0	2.3	0.096	*
A broken filling <sup>(a)</sup>	Yes	25.5	24.7	18.8	15.7	22.7	0.074	*
A broken crown	Yes	6.0	4.4	1.3	3.9	4.6	0.312	n.s.
A loose tooth	Yes	19.9	12.4	11.3	5.3	13.6	0.000	*
A cracked tooth <sup>(a)</sup>	Yes	30.5	28.1	22.5	19.7	26.8	0.078	*
High temperature	Yes	14.9	11.7	7.5	3.3	10.8	0.002	*
Other questions								
Experienced pain	Yes	85.5	84.0	78.8	53.6	78.1	0.000	*
Taking any regular		47.0	48.5	57.5	55.9	50.3	0 161	*
medication <sup>(a)</sup>	Yes	47.0	40.0	01.0	00.0	00.0	0.101	
Sociodemographic variables								
Age group	18–24 years	10.0	7.7	7.5	9.2	8.8	0.001	*
	25–44 years	45.2	43.8	32.5	25.7	39.6		
	45–64 years	26.7	25.5	40.0	33.6	29.0		
	65+ years	18.1	23.0	20.0	31.6	22.6		
Maximum education	Primary	8.5	9.5	15.0	6.6	9.1	0.049	*
	Some							
	secondary	48.8	42.9	28.8	41.4	43.3		
	Completed							
	secondary	19.2	18.9	21.3	17.8	19.0		
	Some	0.0		0.0	4.0	4.0		
		3.0	4.4	0.0	4.0	4.0		
	Completed	6.0	2.2	63	4.6	11		
	Some	0.0	2.2	0.5	4.0	4.4		
	TAFE	4.3	4.7	6.3	5.9	4.9		
	Completed							
	TAFE	7.8	16.4	13.8	17.8	13.3		
	Other	1.8	1.1	_	1.3	1.3		
Sex of patient <sup>(a)</sup>	Female	53.0	56.7	66.3	60.1	57.0	0.154	*
	Male	47.0	43.3	33.8	39.9	43.0		
Language mainly spoken	English	89.7	91.3	86.3	90.2	90.0	0.620	n.s.
at home	Other	10.3	8.7	13.8	9.8	10.0		
Country of birth	Australia	61.1	68.4	63.3	66.0	64.8	0.337	n.s.
	Other	38.9	31.6	36.7	34.0	35.2		
Dental anxiety								
DAS score	DAS score							*
	<13	73.5	80.0	73.8	87.6	78.5	0.004	
	DAS score	26.5	20.0	26.3	12.4	21.5		
	≥13							

#### Table 9: Bivariate associations between independent variables and urgency of care (continued)

Statistically significant chi-square, P<0.05</li>
 Statistically significant Spearman's rho (ordinal-ordinal variables)
 n.s. Not statistically significant
 In the initial selection, a critical P-value of 0.25 was used to avoid rejecting potentially significant variables at this stage.

Bivariate associations between the four subjective oral health scales and urgency of care was also examined. The results are presented in Table 10.

The 'Oral and facial pain symptoms' and 'Other oral symptoms' scales are a 10-item scale with 'yes' and 'no' response options whereby 'yes' is represented by 1 and 'no' by 0. Adding the responses to each item yields a total score ranging from 0 to 10. Zero represents no oral and facial pain symptoms or any other oral symptoms, while 10 represents high experience of oral and facial pain symptoms and other oral symptoms. The mean number of oral symptoms for each urgency of care category is presented in Table 10.

The 'Activities of daily living scale' and 'Worry/concern impact scale' consisted of five and two items respectively. Responses to each item were made on a Likert-type scale whereby respondents were asked to indicate their level of experience with each of the items in question. The response format was a 5-point scale (scored from 1 to 5) ranging from 'all the time' to 'never'. The mean score for each item by category of urgency of care is presented in Table 10.

	(						
	<48	2–7	8–13	14+	Tatal		<b>C</b> :
Scale	nours	days	days	days	Total		Sig.
Oral and facial pain symptoms							
Valid n	255	256	68	106	685	0.000	***
Mean	4.45	3.99	3.24	3.09	3.95		
Std Dev.	2.23	1.94	1.52	1.75	2.05		
Other oral symptoms							
Valid n	228	221	55	110	614	0.000	***
Mean	3.28	3.01	2.36	2.45	2.95		
Std Dev.	1.85	1.97	1.70	1.41	1.84		
Activities of daily living impact scale							
Valid n	283	275	80	153	791	0.000	***
Mean	4.17	4.40	4.63	4.82	4.42		
Std Dev.	0.90	0.78	0.60	0.40	0.79		
Worry/concern impact scale							
Valid n	279	273	80	153	785	0.009	***
Mean	2.78	2.70	2.71	3.16	2.82		
Std Dev.	1.40	1.41	1.40	1.44	1.42		

Table 10	<b>Bivariate associations</b>	hetween sub	iective oral	health scales	and urgency	v of care
Table 10.	Divallate associations	between sub	jective of al	meanin scales	and urgency	y ul cale

\*\*\* Statistically significant ANOVA, P<0.05

A number of variables had a significant association with urgency of care and are marked by asterisks. Significant variables from the bivariate analyses will be further examined by means of logistic regression so as to develop a prediction model for urgency of care.

## Logistic regression

To further examine factors associated with the urgency of care, logistic regression analysis was performed using a range of predictor variables. Each predictor variable with a significant bivariate association with urgency of care (see section 2.4) was entered in a binary logistic regression in order to determine the strengths of the independent association of these variables. The variables included patient characteristics (age, education) and subjective oral health status indicators (experience of pain or other oral symptoms, ability to perform activities of daily living, social and psychological impact of oral disorders).

For the purpose of this analysis, urgency of care has been dichotomised (since the outcome variable in a logistic regression is binary or dichotomous). Three models will be fitted, one for each of the new urgency of care variables:

Urgency of care		New urgency of care					
1 = <48 hours 2 = 2–7 days 3 = 8–13 days 4 = 14+ days	}	<b>Model 1</b> 1 = <48 hours 0 = 2+ days	<b>Model 2</b> 1 = 2–7 days 0 = 8+ days	<b>Model 3</b> 1 = ≤ 7 days 0 = 8+ days			

#### The logistic regression equation – overview

Logistic regression is a generalised linear modelling technique which allows both prediction of the dependent variable and assessment of the importance of individual groups of independent (or predictor) variables.

The goal of logistic regression is to find the best fitting model to describe the relationship between the dependent variable (in this case urgency of care, comprising two categories–'urgent' and 'not urgent') and a set of independent variables. Logistic regression generates the coefficients (and standard errors and significance levels) of a linear function and the probability of being 'urgent' using a linear function (see Equation 1).



e=natural logarithm base,  $b_k$ = regression coefficients,  $x_k$ = value of the independent variable

Logistic regression analysis will be used to classify persons into various treatment urgency categories using the probabilities generated from Equation 1. To do this, rules to determine whether or not a patient falls into a certain category (i.e. 'urgent' or 'not urgent') must be developed. For instance:

- 1. If  $P('urgent') \ge cut-off$  value, then the patient is classified as 'urgent';
- 2. If P('urgent') < cut-off value, then the patient is classified as 'not urgent'.

The results of logistic regression analysis are presented in terms of the probability of being urgent. Therefore, the cut-off value chosen for assignment to a category is critical in evaluating the success of the model since the cut-off value is used to determine how a patient is classified. Different cut-off values give different prediction results in terms of urgency of care. The chosen cut-off value is an arbitrary decision. Generally, the criteria used to select cut-off points are based on ones that conform to the observed prevalence of the gold standard, i.e. the distribution of persons according to the dentist's clinical assessment of urgency.

In order to judge the usefulness of the logistic regression model to predict urgency of care, diagnostic test indicators such as sensitivity, specificity, and positive and negative predictive values (PV+ and PV-) can be calculated for different cut-off values. This will be discussed further in the sections to follow.

### Predicting urgency of care

Before proceeding, it should be noted that acute emergencies are not included in the development of the models. Acute emergencies should have a separate battery of questions that stream patients out immediately. These questions should cover haemorrhage, trauma and facial swelling and should be stringent enough to not miss these particular patients.

#### Model 1: New urgency of care = <48 hours or 2+ days

Of the variables with a statistically significant bivariate association with urgency of care, seven were significant in the binary logistic regression. The logistic regression coefficients were used to estimate odds ratios for each of the independent variables in the model. The coefficients and odds ratios for urgency of care are presented in Table 11.

The odds ratio indicated that persons who experienced pain in their jaw when opening their mouth wide had 2.4 times the odds of requiring treatment within 48 hours compared to those who did not have this symptom.

Persons who reported bleeding gums had 1.5 times the odds of requiring emergency care within 48 hours than those who did not report bleeding gums.

Patients reporting a broken filling had 1.7 times the odds of requiring dental care within 48 hours than persons who did not report a broken filling.

Patients reporting a loose tooth had 2.4 times the odds of requiring dental care within 48 hours than persons who did not report a loose tooth.

The largest statistically significant effect was observed for persons who reported difficulty sleeping all the time because of pain, discomfort or other problems with their teeth, mouth or dentures. These people had 4.8 times the odds of requiring emergency care within 48 hours compared to those who reported no difficulty sleeping.

Those with a DAS score of 13 or more were 1.5 times more likely to need treatment within 48 hours compared to those with a lower score.

Variable	В	S.E.	P-value	OR	Lower	Upper	Sig.
Pain in teeth with cold food/fluids							
Yes	-0.352	0.187	0.060	0.704	0.488	1.015	n.s.
No	REF.						
Pain in jaw when opening mouth wide							
Yes	0.882	0.219	0.000	2.415	1.572	3.712	*
No	REF.						
Shooting pain in face or cheeks							
Yes	0.399	0.210	0.058	1.490	0.987	2.249	n.s.
No	REF.						
Bleeding gums							
Yes	-0.411	0.197	0.037	0.663	0.451	0.975	*
No	REF.						
A broken filling							
Yes	0.501	0.200	0.012	1.650	1.115	2.441	*
No	REF.						
A loose tooth							
Yes	0.855	0.240	0.000	2.352	1.470	3.763	*
No	REF.						
Difficulty sleeping			0.000				*
All the time	1.575	0.259	0.000	4.829	2.960	8.024	*
Very often	1.057	0.323	0.001	2.877	1.528	5.417	*
Often	0.143	0.334	0.670	1.153	0.599	2.220	*
Sometimes	0.659	0.226	0.003	1.933	1.242	3.007	
Never	REF.						
Worried about health of teeth or mouth			0.003				*
All the time	-0.454	0.294	0.123	0.635	0.357	1.131	
Very often	0.507	0.314	0.107	1.661	0.897	3.076	
Often	0.137	0.331	0.679	1.147	0.599	2.193	
Sometimes	0.186	0.305	0.543	1.204	0.662	2.191	
Never	REF.						
Dental anxiety							
DAS score ≥13	0.418	0.204	0.040	1.518	1.018	2.264	*
DAS score <13	REF.						
Model constant	-1.436	0.266	0.000	0.238			

Table 11: Logistic regression coefficients for model 1

Analysis used n = 750 cases with complete data on all variables REF. = Reference category for odds ratio

\* Statistically significant

n.s. Not statistically significant

In terms of the logistic regression equation, the results in Table 11 can be represented as follows:

P('urgent') = 
$$1 + e^{-(b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 + b_7 x_7 + b_8 x_8 + b_9 x_9)}$$

1

(see Table 12 for interpretation of values in this equation.)

i	Independent variable	Response value (x <sub>i</sub> )	Beta coefficient (b <sub>i</sub> )	SE
0	Model constant		-1.436	0.266
1	Pain in teeth with cold food/fluids	1 = Yes	-0.352	0.187
		$0 = No^{\dagger}$		
2	Pain in jaw opening mouth wide	1=Yes	0.882	0.219
		0=No <sup>†</sup>		
3	Shooting pain in face or cheeks	1 = Yes	0.399	0.210
		$0 = No^{\dagger}$		
4	Bleeding gums	1 = Yes	-0.411	0.197
		$0 = No^{\dagger}$		
5	A broken filling	1=Yes	0.501	0.200
		0=No <sup>†</sup>		
6	A loose tooth	1 = Yes	0.855	0.240
		$0 = No^{\dagger}$		
7	Difficulty sleeping	1 = All the time	1.575	0.259
		2 = Very Often	1.057	0.323
		3 = Often	0.143	0.334
		4 = Sometimes	0.659	0.226
		5 = Never <sup>†</sup>		
8	Worried about the health of teeth or mouth	1 = All the time	-0.454	0.294
		2 = Very Often	0.507	0.314
		3 = Often	0.137	0.331
		4 = Sometimes	0.186	0.305
		5 = Never <sup>†</sup>		
9	Dental anxiety	1 = DAS score≥13	0.418	0.204
		0 = DAS score<13 <sup>†</sup>		

# Table 12: Independent predictor variables for Model 1: response values, logistic regression beta coefficients and standard errors

† Reference category

N.B.Because the equation is solved for the outcome 'urgency: <48 hours', the derived probabilities are also for urgency of <48 hours.

#### Model 2: New urgency of care = 2–7 days or 8+ days

Of the variables with a statistically significant bivariate association with urgency of care, six were significant in the binary logistic regression. Once again, the logistic regression coefficients were used to estimate odds ratios for each of the independent variables in the model. The coefficients and odds ratios for urgency of care are presented in Table 13.

As can be seen from Table 13, those reporting to have had a toothache in the last week are 2.6 times more likely to require emergency treatment within 2–7 days compared to those who did not have a toothache.

Those persons reporting pain in their teeth with hot food or fluids, bleeding gums and/or a broken tooth had 2.0 times the odds of needing emergency treatment within 2–7 days compared to those persons not reporting these symptoms.

Those who experienced difficulty sleeping all the time because of pain, discomfort or other problems with their teeth, mouth or dentures had 2.9 times the odds of requiring emergency dental treatment within 2–7 days than those who had no difficulty sleeping.

Persons who reported worrying about the appearance of their teeth or mouth very often had 3.3 times the odds of requiring emergency care within 2–7 days than those who didn't report the same concern.

Variable	В	S.E.	P-value	OR	Lower	Upper	Sig.
Toothache							
Yes	0.967	0.253	0.000	2.629	1.600	4.319	*
No	REF.						
Pain in teeth with hot food or fluids							
Yes	0.651	0.219	0.003	1.917	1.248	2.945	*
No	REF.						
Pain worse in the middle of the day							
Yes	0.633	0.352	0.072	1.883	0.945	3.752	n.s.
No	REF.						
Bleeding gums							
Yes	0.698	0.235	0.003	2.009	1.268	3.184	*
No	REF.						
A broken filling							
Yes	0.732	0.265	0.006	2.080	1.238	3.495	*
No	REF.						
Difficulty sleeping			0.007				*
All the time	1.079	0.393	0.006	2.941	1.361	6.355	*
Very often	1.072	0.499	0.032	2.920	1.098	7.761	*
Often	0.981	0.398	0.014	2.668	1.224	5.817	*
Sometimes	0.156	0.272	0.566	1.169	0.686	1.992	
Never	REF.						
Worried about appearance of teeth/mouth			0.011				*
All the time	-0.407	0.276	0.141	0.665	0.387	1.144	
Very often	-1.189	0.394	0.003	0.305	0.141	0.659	*
Often	0.270	0.400	0.500	1.309	0.598	2.866	
Sometimes	-0.586	0.306	0.055	0.556	0.305	1.014	
Never	REF.						
Model constant	-1.213	0.248	0.000	0.297			

 Table 13:
 Logistic regression coefficients for model 2

Analysis used n = 476 cases with complete data on all variables

REF. = Reference category for odds ratio

Statistically significant

n.s. Not statistically significant

In terms of the logistic regression equation, the results in Table 13 can be represented as follows:

P('urgent') = 
$$\frac{1}{1 + e^{-(b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 + b_7 x_7)}}$$

(see Table 14 for interpretation of values in this equation.)

i	Independent variable	Response value (x <sub>i</sub> )	Beta coefficient (b <sub>i</sub> )	SE
0	Model constant		-1.213	0.248
1	Toothache	1 = Yes	0.967	0.253
		$0 = No^{\dagger}$		
2	Pain in teeth with hot food/fluids	1 = Yes	0.651	0.219
		$0 = No^{\dagger}$		
3	Pain worse in the middle of the day	1 = Yes	0.633	0.352
		$0 = No^{\dagger}$		
4	Bleeding gums	1 = Yes	0.698	0.235
		$0 = No^{\dagger}$		
5	Broken filling	1 = Yes	0.732	0.265
		$0 = No^{\dagger}$		
6	Difficulty sleeping	1 = All the time	1.079	0.393
		2 = Very Often	1.072	0.499
		3 = Often	0.981	0.398
		4 = Sometimes	0.156	0.272
		5 = Never <sup>†</sup>		
7	Worried about appearance of teeth or mou	uth 1 = All the time	-0.407	0.276
		2 = Very Often	-1.189	0.394
		3 = Often	0.270	0.400
		4 = Sometimes	-0.586	0.306
		$5 = Never^{\dagger}$		

 Table 14: Independent predictor variables for Model 2: response values, logistic regression beta coefficients and standard errors

† Reference category

N.B. Since the equation is solved for the outcome 'urgency: 2-7 days', the derived probabilities are also for urgency of 2-7 days.

#### Model 3: New urgency of care = $\leq 7$ days or 8+ days

Logistic regression coefficients and odds ratios for model 3 are presented in Table 15.

Persons reporting a toothache had 2.2 times the odds as person not reporting a toothache to require emergency dental care within 7 days.

Those who reported a broken filling had 2.3 times the odds of needing emergency care within the week than those not reporting a broken filling.

Those who reported a loose tooth had 1.9 times the odds of requiring care within 7 days compared to those not reporting any loose teeth.

Those who experienced difficulty sleeping all the time because of pain, discomfort or other problems with their teeth, mouth or dentures had 5.3 the odds of requiring emergency dental treatment within 7 days than those who had no difficulty sleeping. Similarly, those who had difficulty sleeping very often had 4.3 times the odds of requiring dental care within the week compared to those who did not report difficulty sleeping.

Persons who reported worrying about the appearance of their teeth or mouth very often were 2.0 times less likely to require emergency dental care with 7 days compared to those who did not worry about the appearance of their teeth or mouth.

Table 15:	Logistic	regression	coefficients	for model 3

Variable	В	S.E.	P-value	OR	Lower	Upper	Sig.
Toothache							
Yes	0.775	0.207	0.000	2.171	1.448	3.254	*
No	REF.						
Pain worse in the middle of the day							
Yes	0.618	0.328	0.059	1.855	0.976	3.526	n.s.
No	REF.						
Shooting pain in face or cheeks							
Yes	0.453	0.262	0.083	1.573	0.942	2.628	n.s.
No	REF.						
Sore gums							
Yes	-0.322	0.214	0.132	0.725	0.476	1.102	n.s.
No	REF.						
Bleeding gums							
Yes	0.360	0.213	0.091	1.433	0.944	2.176	n.s.
No	REF.						
Changes in ability to taste							
Yes	0.534	0.307	0.082	1.706	0.934	3.116	n.s.
No	REF.						
A broken filling							
Yes	0.815	0.228	0.000	2.258	1.445	3.529	*
No	REF.						
A loose tooth							
Yes	0.666	0.313	0.033	1.945	1.054	3.591	*
No	REF.						
Difficulty sleeping			0.000				*
All the time	1.669	0.359	0.000	5.309	2.627	10.279	*
Very often	1.455	0.459	0.002	4.286	1.745	10.528	*
Often	0.952	0.368	0.010	2.590	1.260	5.327	*
Sometimes	0.469	0.231	0.043	1.599	1.016	2.516	*
Never	REF.						
Worried about appearance of teeth/mouth			0.050				*
All the time	-0.336	0.239	0.160	0.715	0.447	1.142	
Very often	-0.674	0.319	0.035	0.510	0.273	0.953	*
Often	0.477	0.348	0.170	1.611	0.815	3.185	
Sometimes	-0.137	0.254	0.590	0.872	0.529	1.435	
Never	REF.						
Model constant	-0.442	0.200	0.027	0.642			

Analysis used n = 750 cases with complete data on all variables REF. = Reference category for odds ratio

\* Statistically significant n.s. Not statistically significant

In terms of the logistic regression equation, the results in Table 15 can be represented as follows:

P('urgent') = 
$$\frac{1}{1 + e^{-(b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 + b_7 x_7 + b_8 x_8 + b_9 x_9 + b_{10} x_{10})}$$

(see Table 16 for interpretation of values in this equation.)

i	Independent variable	Response value (x <sub>i</sub> )	Beta coefficient (b <sub>i</sub> )	SE
0	Model constant		-0.442	0.200
1	Toothache	1 = Yes	0.775	0.207
		$0 = No^{\dagger}$		
2	Pain worse in the middle of the day	1 = Yes	0.618	0.328
		$0 = No^{\dagger}$		
3	Shooting pain in face or cheeks	1 = Yes	0.453	0.262
		$0 = No^{\dagger}$		
4	Sore gums	1 = Yes	-0.322	0.214
		$0 = No^{\dagger}$		
5	Bleeding gums	1 = Yes	0.360	0.213
		$0 = No^{\dagger}$		
6	Changes in ability to taste	1 = Yes	0.534	0.307
		$0 = No^{\dagger}$		
7	Broken filling	1 = Yes	0.815	0.228
		$0 = No^{\dagger}$		
8	Loose tooth	1 = Yes	0.666	0.313
		$0 = No^{\dagger}$		
9	Difficulty sleeping	1 = All the time	1.669	0.359
		2 = Very Often	1.455	0.459
		3 = Often	0.952	0.368
		4 = Sometimes	0.469	0.231
		5 = Never <sup>†</sup>		
10	Worried about appearance of teeth or m	outh 1 = All the time	-0.336	0.239
		2 = Very Often	-0.674	0.319
		3 = Often	0.477	0.348
		4 = Sometimes	-0.137	0.254
		5 = Never <sup>†</sup>		

 Table 16: Independent predictor variables for Model 3: response values, logistic regression beta coefficients and standard errors

† Reference category

N.B. Since the equation is solved for the outcome 'urgency:  $\leq$ 7 days', the derived probabilities are also for urgency of  $\leq$ 7 days.

## **Diagnostic test indicators**

The fundamental question to be answered is 'Is a patient 'urgent' or 'not urgent'?'. The logistic regression models are used to discriminate between 'urgent' and 'not urgent' patients. To determine just how accurately this question can be answered using the models, various measures of test performance can be examined.

#### Sensitivity, specificity and predictive values

Clinicians use measures of test performance such as sensitivity, specificity, positive predictive value (PV+) and negative predictive value (PV-) to assess each model's ability to predict urgency of dental treatment.

Sensitivity and specificity describe the accuracy of the model. Sensitivity measures how accurately the model identifies urgent patients, i.e. the true positive rate, while the specificity measures how accurately the model identifies non-urgent patients i.e. the true negative rate. A sensitive test identifies most of the patients who are urgent and perhaps a few who are not. A specific test identifies most of the patients who are not urgent and maybe a few who are.

The predictive value of a positive test is the probability that a patient with a positive test result is urgent, while the predictive value of a negative test is the probability that a patient with a negative test result is not urgent.

A simple way of looking at the relationships between a test's results and the clinician assessment of urgency is shown in Table 17. The test is considered to be either positive or negative and the clinician's assessment of urgency as either 'urgent' or 'not urgent'. There are four possible interpretations of test results, two of which are correct (true positive and true negative) and two wrong (false positive and false negative). The test has given the correct answer when it is positive when a patient is urgent (true +ve) or negative when a patient is not urgent (true -ve). On the other hand, the test has been misleading if it is positive when a patient is not urgent (false +ve) and negative when a patient is urgent (false -ve).

The relationships between the test result and clinician urgency are summarised in Table 17 in terms of sensitivity, specificity, PV+ and PV-.

		Clinician urgency (clinical assessment of urgency)		
		Urgent +ve	Not urgent -ve	Total
Test result	Urgent +ve	a (TP)	b (FP)	a + b
(based on predictor variables)	Not urgent -ve	c (FN)	d (TN)	c + d
	Total	a + c	b + d	Ν

Table 17: Rela	tionship between	a diagnostic test	result and clinician	assessment of urgency
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Notes

1. Sensitivity = a/(a+c), Specificity = d/(d+b), PV+ = a/(a+b), PV- = d/(c+d), a+b+c+d = N

2. TP = true positive, FP = false positive, FN = false negative, TN = true negative

Source: Fletcher, Fletcher & Wagner 1996

#### Hypothetical distribution of test results

A hypothetical distribution of test results for 'not-urgent' and 'urgent' individuals is illustrated in Figure 1.

Because the 'not urgent' and 'urgent' ranges of values often overlap, a cut-off point in the overlapping range is used to define the 'decision threshold' that can be varied to alter the test's sensitivity and specificity. The position of the cut-off point between 'negative' and 'positive' test results determines the test's sensitivity and specificity. The cut-off point is the value above which a test is interpreted as 'urgent'. If the cut-off point is modified, sensitivity will be enhanced at the expense of specificity and vice versa. Cut-off values are selected such that the desired sensitivity and specificity are achieved.



Choosing cut-off point C = 0.6 eliminates false positive results but increases the proportion of false negative test results. In this case the test would have 100% specificity but low sensitivity.

#### **Figure 1: Hypothetical distribution of test results**

As illustrated in Figure 1, an important use of the concepts of sensitivity, specificity and predictive values is in the determination of an optimal cut-off value or clinical decision limit for a test. Sensitivity and specificity are dependent on the cut-off value selected – the decision on what cut-off value to choose is arbitrary. It is important to note that whenever a clinical decision limit is changed, there is a trade-off between the sensitivity and specificity of a test.

For example, it would be desirable to maximise sensitivity (i.e. have few false –ves) when there is an important penalty (social impact/political) for missing an urgent case; or to maximise specificity (i.e. have few false +ves) when it is important (in terms of equity and allocative efficiency) not to treat false +ves as urgent. Note that some sort of 'safety net' or appeal mechanism should be considered for false –ves who recontact the clinic for care.

Clinicians have to collaborate and agree on the balance of false positives versus false negatives for each diagnostic situation. The intended clinical use of a test will also be a factor in selecting the best cut-off value. In a given clinical setting the consequences of a false negative result may be far more serious than those of a false positive result and vice versa. There is no simple way to select the optimum combination of sensitivity and specificity. The choice depends on the nature of the disease, the clinical population and the relative cost of a false positive or false negative result.

In the next section the relationship between the cut-off point and sensitivity/specificity will be examined through the construction of receiver operating characteristic (ROC) curves.

#### **ROC curves**

A useful way to present the characteristics of a diagnostic test is through a receiver operating characteristic (ROC) curve. A ROC curve can be constructed by plotting the true positive rate (sensitivity) against the false positive rate (1–specificity) for the different possible cut-off values of a diagnostic test. The values on the axes run from a probability of 0 to 1.0, or alternatively from 0% to 100% (Figure 2).

ROC curves show how severe the trade-off between sensitivity and specificity is for a test and can be used to help decide where the best cut-off point would be. ROC curves represent the accuracy of a test over a range of cut-off points. As the decision threshold is varied (i.e. as the cut-off point that separates 'not-urgent' patients from 'urgent' ones is changed), the sensitivity and specificity of the test also change. The best cut-off point for balancing the sensitivity and specificity of a test is the one on the curve closest to the upper left-hand corner. Cut-off points closest to the upper left-hand corner maximise the number of true positive results and minimise the number of false positive results. A ROC curve that operates no better than chance for detecting urgent patients will lie along the 45-degree line that runs from the intersection of the X and Y axes to the upper right-hand corner of the graph. Points on this line indicate that the test provides an equal number of true positives and false positives; that is, it does not discriminate between 'not urgent' and 'urgent' patients.


## ROC curve for emergency model 1

The ROC curve for emergency model 1 examining urgency of <48 hours vs 2+ days is shown in Figure 3. If the probability of needing care within 48 hours is required to be greater than 0.7 to diagnose urgent cases, all patients diagnosed as 'urgent' would certainly be urgent, but many other urgent people would be missed using this definition of urgency. The test would be very specific at the expense of sensitivity.

At the other extreme, if anyone with a probability of needing care within 48 hours is less than 0.2, very few urgent patients would be missed, but most non-urgent people would be falsely labelled as being urgent. The test would then be very sensitive but nonspecific.

The key point is that there is generally a trade-off between the sensitivity and specificity of a test. It is obviously desirable to have a test that is both highly sensitive and highly specific but this is usually not possible. A trade-off between sensitivity and specificity is required when clinical data take on a range of values. In these situations the location of a cut-off point on the continuum between non-urgent and urgent is an arbitrary decision.



## ROC curve for emergency model 2

The ROC curve for emergency model 2 examining urgency of 2–7 days vs 8+ days is shown in Figure 4. The cut-off values on the curve represent the probability of needing treatment in 2–7 days.

If we want to ensure that more urgent patients are not missed, a low cut-off point should be chosen. To have fewer false positives (i.e. correctly identify more non-urgent patients), a higher cut-off value should be considered.



## ROC curve for emergency model 3

The ROC curve for emergency model 3 examining urgency of  $\leq$ 7 days vs 8+ days is shown in Figure 5. The cut-off values on the curve represent the probability of needing treatment within 7 days.



## Results - diagnostic test indicators

This section presents tables detailing the trade-off between the sensitivity and specificity of a test when different cut-off points are chosen, along with the predictive values of the test at each cut-off point. By varying the cut-off point, different values of sensitivity and specificity are obtained. Sensitivity and specificity exhibit opposite behaviours: a higher value of sensitivity is paid for by a lower value of specificity. The relative consequences of false negative and false positive test results need to be considered when selecting the cut-off point.

## **Emergency model 1**

Sensitivity, specificity, positive predictive values (PV+) and negative predictive values (PV-) calculated for emergency model 1 at varying cut-off values are presented in Table 18.

Cut-off	Sensitivity	Specificity	PV+	PV-
0.2	0.88	0.36	0.43	0.84
0.3	0.73	0.61	0.51	0.81
0.4	0.58	0.77	0.59	0.77
0.5	0.45	0.88	0.67	0.74
0.6	0.30	0.94	0.75	0.71
0.7	0.16	0.98	0.78	0.68

Table 18: Sensitivity, specificity and predictive values for emergency model 1

If sensitivity and specificity are regarded as being of equal importance, a cut-off value somewhere around 0.3 might be chosen. However, choosing a test that results in the same sensitivity and specificity implies that the costs of a false positive and false negative test results are equivalent.

Suppose a cut-off value of 0.20 is chosen. The test is therefore 88% sensitive, meaning that 88% of urgent patients test positive and12% are potentially misclassified (i.e. 12% of urgent people will be missed). Specificity for the test is 36%, meaning that 36% of non-urgent patients test negative (i.e. 64% of non-urgent patients will be misclassified as urgent). If the test is positive, the probability of being urgent is 43% but there is a 57% chance that the patient is not urgent. If the test is negative, the probability of being urgent is 16%, which indicates an 84% chance that the patient is not urgent.

Suppose a cut-off value of 0.70 is chosen. The test sensitivity in this case is 16%, which indicates that 16% of urgent patients test positive and 84% are potentially misclassified (i.e. 84% of urgent people will be missed). Specificity for the test is 98%, meaning that 98% of non-urgent patients test negative (i.e. 2% of non-urgent patients will be misclassified as urgent). If the test is positive, the probability of being urgent is 78% but there is still a 22% chance that the patient is not urgent. If the test is not urgent is not urgent.

## Example interpretation of emergency model 1

Suppose there are 100 patients presenting for emergency dental care. According to the assessing dentist, approximately 36% require care within 48 hours and a further 64% are classified as being able to wait 2 or more days for treatment (see Table 7).

However, of those patients classified as urgent (i.e. requiring care within 48 hours), the number actually seen within 48 hours will depend on the cut-off value selected. To illustrate this, the model is interpreted for two different cut-off values, a low cut-off of 0.2 and a high cut-off of 0.7.

Cut-off	Sensitivity	Specificity	PV+	PV-
0.2	0.88	0.36	0.43	0.84

## **Decision 1: cut-off = 0.2**

The first thing to note is the model has high sensitivity but low specificity when using a cut-off value of 0.2. This indicates that the model will tend to identify most urgent cases (i.e. have fewer false negative results) but at the same time will also identify more non-urgent patients as urgent (i.e. have more false positives results).

Therefore, using a cut-off value of 0.2, the model sensitivity is 88%. The specificity is 36%, indicating that of those 36 patients actually requiring care within 48 hours, 32 (88%) will be correctly identified as urgent and will therefore be seen within 48 hours, but 4 patients (12%), will be misclassified and receive care in 2 or more days time (i.e. 4 patients end up with false negative results).

Of the 64 patients who are considered able to wait 2 or more days for treatment, 23 (36%) without urgent need will actually test negative but 41 (64%) will be misclassified (i.e. 41 patients end up with false positive results) and receive care within 48 hours.

These results are summarised in Table 19. Of the 100 patients presenting for emergency care, 27 will not be seen immediately.

# Table 19: Example using emergency model 1 with cut-off = 0.2 to assign priority to 100patients presenting for emergency dental care

		Clinician urger (clinical assessment c	ncy of urgency)	
		<48 hours (+ve)	2+days (-ve)	Total
Test result	<48 hours +ve	32	41 (FP)	73
(based on predictor variables)	2+ days -ve	4 (FN)	23	27*
	Total	36	64	100

\* Not seen

FP = false positive, FN = false negative

#### **Decision 2: cut-off = 0.7**

Cut-off	Sensitivity	Specificity	PV+	PV-
0.7	0.16	0.98	0.78	0.68

Using a higher cut-off value increases the specificity at the expense of the sensitivity. In this particular case, 30 patients end up with false negative test results and only 1 patient ends up with a false positive result (Table 20).

		Clinician urgen (clinical assessment o	cy f urgency)	
		<48 hours (+ve)	2+days (-ve)	Total
Test result	<48 hours +ve	6	1 (FP)	7
(based on predictor variables)	2+ days -ve	30 (FN)	63	93
	Total	36	64	100

# Table 20: Example using emergency model 1 with cut-off = 0.7 to assign priority to 100 patients presenting for emergency dental care

FP = false positive, FN = false negative

Similar calculations can be made for the other cut-off values (see Appendix A1).

#### **Emergency model 2**

Sensitivity, specificity, positive predictive values (PV+) and negative predictive values (PV-) calculated for emergency model 2 at varying cut-off values are presented in Table 21.

Cut-off	Sensitivity	Specificity	PV+	PV-
0.2	0.97	0.12	0.56	0.79
0.3	0.91	0.35	0.62	0.76
0.4	0.84	0.49	0.66	0.73
0.5	0.75	0.65	0.71	0.69
0.55	0.67	0.71	0.73	0.65
0.6	0.63	0.77	0.76	0.64
0.7	0.44	0.90	0.84	0.58

Table 21: Sensitivity, specificity and predictive values for emergency model 2

Suppose, for example, a cut-off value of 0.40 is chosen. The test is 84% sensitive, meaning that 84% of urgent patients test positive and 16% are potentially misclassified (i.e. 16% of urgent people will be missed). Specificity for the test is 49%, meaning that 49% of non-urgent patients test negative (i.e. 51% of non-urgent patients will be misclassified as urgent). If the test is positive, the probability of being urgent is 66%, but there is a 34% chance that the patient is not urgent. If the test is negative, the probability of being urgent is 27%, which indicates a 73% chance that the patient is not urgent.

#### Example interpretation of emergency model 2

When a cut-off value of 0.2 was used for emergency model 1, 27 of the 100 patients presenting for emergency dental care were not classified as needing to be seen immediately, i.e. 73 were classified as requiring care within 48 hours while the remaining 27 patients were considered able to wait 2+ days for dental treatment.

Consider what happens to these 27 patients when emergency model 2 is used (assuming a cut-off value of 0.2 for emergency model 1). To determine how many of these 27 patients are classified as needing to be seen in the period 2–7 days or in 8+ days, a cut-off value needs to be selected. As discussed previously, the predictive capability of the model is dependent upon the cut-off value chosen. To illustrate this, emergency model 2 is interpreted for 2 different cut-off values, a low cut-off of 0.4 and a high cut-off of 0.7.

#### **Decision 1: cut-off = 0.4**

Cut-off	Sensitivity	Specificity	PV+	PV-
0.4	0.84	0.49	0.66	0.73

Based on the above values of sensitivity, specificity and positive and negative predictive values, and solving the relationships between the test result and the clinician's urgency assessment presented in Table 17, the following results are obtained (Table 22).

# Table 22: Example using emergency model 2 with cut-off = 0.4 to assign priority to the patients not classified as requiring care within 48 hours

		Clinician urge (clinical assessment o	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result	2–7 days +ve	12	7 (FP)	19
(based on predictor variables)	8+ days -ve	2 (FN)	6	8
	Total	14	13	27

FP = false positive, FN = false negative

The results presented in Table 22 show that 8 of the 27 patients initially presenting for emergency care are classified as able to wait 8 or more days for dental care.

## Decision 2: cut-off =0.7

Cut-off	Sensitivity	Specificity	PV+	PV-
0.7	0.44	0.90	0.84	0.58

Using a higher cut-off value (0.7) increases the specificity at the expense of the sensitivity. Therefore, there will be fewer false positive results but more false negative test results (Table 23).

Table 23: Example using emergency model 2 with cut-off = 0.7 to assign priority to the patients not classified as requiring care within 48 hours

		Clinician urge clinical assessment (	ency of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result	2–7 days +ve	7	1 (FP)	8
(based on predictor variables)	8+ days -ve	8 (FN)	11	19
	Total	15	12	27

FP = false positive, FN = false negative

The results presented in Table 23 show that 19 of the 27 patients initially presenting for emergency care are classified as able to wait 8 or more days for dental care.

Similar calculations can be made for the other cut-off values (see Appendix A1).

## **Emergency model 3**

Sensitivity, specificity, positive predictive values (PV+) and negative predictive values (PV-) calculated for emergency model 3 at varying cut-off values are presented in Table 24. As the cut-off value is lowered, the sensitivity increases but the specificity decreases.

Cut-off	Sensitivity	Specificity	PV+	PV-
0.2	1.00	0.00	0.70	0.00
0.3	0.99	0.04	0.71	0.67
0.4	0.93	0.24	0.74	0.61
0.5	0.89	0.40	0.77	0.62
0.6	0.80	0.61	0.83	0.56
0.7	0.66	0.73	0.85	0.47
0.8	0.49	0.87	0.90	0.42
0.9	0.26	0.96	0.93	0.35

Table 24: Sensitivity, specificity and predictive values for emergency model 3

Suppose the cut-off value is set at 0.6. Of the patients who actually are urgent, 80% will have positive test results. This is the percentage of 'true positive' results. The remaining 20% of urgent patients have negative test results but are nonetheless urgent. This is the percentage of patients with 'false negative' test results, i.e. 20% of urgent people will be misclassified as not urgent.

Of the patients who are not urgent, 61% will have negative test results. This is the percentage of 'true negative' results. The remaining 39% of non-urgent patients have positive test results, but are not urgent. This is the percentage of patients with 'false positive' test results, i.e. 39% of non-urgent patients will be misclassified as urgent.

If the test is positive, the probability of being urgent is 83% (i.e. 83 of 100 patients with positive test results will likely be urgent). Hence, if the test is positive, there is a 17% chance that the patient is not urgent. If the test is negative, the probability of being urgent is 44%, which indicates a 56% chance that the patient is not urgent.

## Example interpretation of emergency model 3

Suppose there are 100 patients presenting for emergency dental care. According to the assessing dentist, approximately 71% require care within 7 days (i.e. 36% require care within 48 hours and a further 35% need to be seen between 2 and 7 days) and the remaining 29% are considered able to wait 8 or more days for dental care (i.e. 10% are classified as requiring care in 8–13 days and 19% are considered able to wait 14+ days for treatment) (see Table 7).

Let us now consider what happens to these 100 patients when a cut-off point of 0.6 is selected.

Cut-off	Sensitivity	Specificity	PV+	PV-
0.6	0.80	0.61	0.83	0.56

#### **Decision 1: cut-off = 0.6**

Using a cut-off value of 0.6, the model sensitivity is 80%. The specificity is 61%, indicating that of those 71 patients actually requiring care within 7 days, 57 (80%) will be correctly identified as urgent and will therefore be seen within 7 days, but 14 patients (20%) will be misclassified and receive care in 8 or more days time (i.e. 14 patients end up with false negative results).

Of the 29 patients who are considered able to wait 8 or more days for treatment, 18 (61%) without urgent need will actually test negative but 11 (39%) will be misclassified (i.e. 11 patients end up with false positive results) and receive care within 7 days.

These results are summarised in Table 25. Of the 100 patients presenting for emergency care, 32 will not be seen within 7 days.

Table 25: Example using emergency model 3 with cut-off = 0.6 to assign priority to	
100 patients presenting for emergency dental care	

		Clinician urgency (clinical assessment of urgency)		
		≤7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	≤7 days +ve	57	11 (FP)	68
	8+ days -ve	14 (FN)	18	32*
	Total	71	29	100

\* Not seen

FP = false positive, FN = false negative

Similar calculations can be made for the other cut-off values (see Appendix A1).

#### False negative results

One important question left to answer is 'What happens to patients who receive a false negative classification in these models?'

Recall that patients with a false negative result are patients who are in fact 'urgent' but instead are incorrectly classified as 'not urgent'.

The main concern here is that these urgent patients will go untreated, potentially leading to the deterioration of their oral health condition and increasing the risk of their condition impacting negatively on their quality of life.

There are, however, systemic steps that can be taken to widen the 'safety net' for such patients. One such step would be to develop and implement a procedure which tags patients who are misclassified (i.e. classified as 'not urgent' and are sent away or their treatment is delayed). If they were to recontact the clinic they would be immediately identifiable and could be asked to come in for an assessment to ascertain their true treatment need status.

# **3 General dental care**

# 3.1 Participants

Of the 900 participants required for the general component of the RNI Study, 740 patients requesting routine dental care were recruited across SA and NSW. Overall, 82.2% of the anticipated sample was collected. A breakdown of the sample collected at each clinic in each state is given in Table 26.

In SA 471 eligible patients requesting routine dental care were recruited for the study. Overall, 85.6% of the required sample for SA was collected. In NSW, 269 patients were selected for inclusion in the study, making up 76.9% of the required sample for that state.

State	Community Dental Service Clinic	Anticipated sample size	Sample size achieved	
SA	East Marden	80	49	
	Gawler	60	60	
	Gilles Plains	130	133	
	Kadina	30	31	
	Parks	90	92	
	Somerton Park	100	101	
	Victor Harbor	60	4	
	SA total	550	471	(85.6%)
NSW	United Dental Hospital	120	129	
	Western Sydney Area Health Service – Mt Druitt	70	70	
	Illawarra Area Health Service – Bulli	70	70	
	South Western Sydney Area Health Service – Narellan	90	0	
	NSW total	350	269	(76.9%)
	Total sample	900	740	(82.2%)

Table 26: Sample size collected from selected dental clinics in SA and NSW

# 3.2 Population characteristics

## Sociodemographic characteristics of respondents

The percentages of respondents in each of several sociodemographic groupings for both SA and NSW, as well as in the overall sample are shown in Table 27.

Almost 42% of respondents were aged 25–44 years and a further 28% were aged 45–64 years, while 9.1% were in the youngest age group, which spanned only 7 years. There is an over-representation of females in the sample but this could be because females tend to use dental services more so than men. The majority of respondents had completed some or all of their secondary school education (59.3%), 32.1% had some secondary school education and a further 27.2% had completed secondary school. Almost 52% of patients presenting for general dental care held a full-entitlement pensioner concession card and approximately 43% of the sample had a health care card.

	SA	NSW	Total
	(n = 471)	(n = 269)	(n = 740)
	%	%	%
Age group	n = 469	n = 268	n = 737
18–24 years	10.4	6.7	9.1
25–44 years	39.7	44.8	41.5
45–64 years	27.9	28.4	28.1
65+ years	22.0	20.1	21.3
Sex of patient	n = 471	n = 269	n = 740
Male	41.0	45.4	42.6
Female	59.0	54.6	57.4
Born in Australia	n = 471	n = 268	n = 739
Yes	60.1	53.0	57.5
No	39.9	47.0	42.5
Language mainly spoken at home <sup>*</sup>	n = 471	n = 269	n = 740
English	89.8	73.6	83.9
Other	10.2	26.4	16.1
Indigenous status <sup>*</sup>	n = 470	n = 268	n = 738
No	98.9	95.1	97.6
Yes, Aboriginal	1.1	2.2	1.5
Yes, Torres Strait Islander	-	2.6	0.9
Highest level of education	n = 471	n = 268	n = 739
Primary school	6.4	7.1	6.6
Some secondary school	33.8	29.1	32.1
Completed secondary school	26.1	29.1	27.2
Some university or higher education	7.9	5.6	7.0
Completed university or higher education	8.1	7.1	7.7
Some TAFE, CAE or vocational course	7.0	6.7	6.9
Completed TAFE, CAE or vocational course	9.6	13.4	11.0
Other	1.3	1.9	1.5
Usual/previous occupation	n = 453	n = 261	n = 714
Manager/professional	11.3	11.5	11.3
Para-professional/trade	22.3	18.0	20.7
Clerk/sales/driver/labourer	45.0	50.6	47.1
Self-employed	1.8	1.1	1.5
Home duties	8.6	12.6	10.1
Other	11.0	6.1	9.2
Health care card status	n = 470	n = 269	n = 739
Pensioner Concession Card (full) only	48.5	57.2	51.7
Pensioner Concession Card (part) only	4.0	2.2	3.4
Health Care Card only	45.1	38.3	42.6
Other card(s)	2.3	2.2	2.3

## Table 27: Distribution of sample sociodemographic characteristics by state

\* Statistically significant chi-square, P<0.05

## Access to dental services

Dental visiting patterns of respondents in both SA and NSW, and in the overall sample, are shown in Table 28.

Almost 60% of respondents reported that a dental problem was their usual reason for a dental visit and 35% visited a dentist in the last 12 months. It should be noted that those who last visited a dentist 12 months ago would have visited for emergency care since the inclusion criteria for the general RNI sample states that patients should not have visited the dentist for routine dental care in the last year. Just over 60% of respondents received their last course of care at a public dental hospital/clinic.

	SA	NSW	Total
	(n = 471)	(n = 269)	(n = 740)
	%	%	%
Dentate status	n = 470	n = 268	n = 738
Natural teeth only	82.6	78.0	80.9
Denture (U and/or L) and natural teeth	17.4	22.0	19.1
Private dental insurance <sup>*</sup>	n = 471	n = 269	n = 740
Yes	5.1	1.9	3.9
No	94.9	98.1	96.1
Usual reason for visit <sup>*</sup>	n = 470	n = 263	n = 733
Check-up	51.5	14.1	38.1
Problem/pain	44.3	81.7	57.7
Check-up/problem/pain	4.3	4.2	4.2
Time since last visit <sup>*</sup>	n = 469	n = 268	n = 737
<12 months	27.1	48.9	35.0
12–<2 years	20.3	15.3	18.5
2–<3 years	15.8	10.4	13.8
3–<5 years	17.7	10.4	15.1
5+ years	19.0	14.6	17.4
Never	0.2	0.4	0.3
Place of last visit	n = 464	n = 267	n = 731
Private practice	35.3	27.0	32.3
Public hospital/clinic	53.7	71.5	60.2
School Dental Service	8.8	1.1	6.0
Other	2.2	0.4	1.5
Frequency of dental visits <sup>*</sup>	n = 467	n = 266	n = 733
More than 2 times a year	5.6	6.4	5.9
2 times a year	7.5	7.1	7.4
Once a year	16.1	13.2	15.0
Once every 2 years	34.0	22.6	29.9
Once every 5 years	23.3	19.9	22.1
Less often than that	13.5	30.8	19.8

#### Table 28: Dental visiting factors by state

\* Statistically significant chi-square, P<0.05

## 3.3 Data variables

## **Dependent variable**

The aim of this study was to determine levels of priority of those people seeking routine dental care. Urgency of care, based on the assessing dentist's clinical judgment, was therefore used as the dependent variable. This variable consists of the following four categories into which a patient's urgency for dental treatment may be classified by the assessing dentist: <1 month, 1–3 months, 4–6 months or 7+ months.

## Independent variables

Questionnaire variables were developed from the literature to reflect potential predictors of urgency of care. These variables are described in Table 29.

Sociodemographic variables	age group
	sex of patient
	born in Australia
	language mainly spoken at home
	maximum education
Dental visiting factors	usual reason for visit
	time since last dental visit
	place of last dental visit
	frequency of dental visits
Ability to chew <sup>(a)</sup>	Are you usually able to:
	chew a piece of fresh carrot?
	chew boiled vegetables?
	chew fresh lettuce salad?
	<ul> <li>chew firm food such as steaks or dried apricots?</li> </ul>
	<ul> <li>bite off and chew a piece of whole fresh apple?</li> </ul>
	chew hamburger?
	Response format: yes/no
Ability to speak <sup>(a)</sup>	Thinking about problems with your teeth or mouth
Ability to speak <sup>(a)</sup>	<ul><li>Thinking about problems with your teeth or mouth</li><li>do you ever have difficulty pronouncing any words?</li></ul>
Ability to speak <sup>(a)</sup>	<ul><li>Thinking about problems with your teeth or mouth</li><li>do you ever have difficulty pronouncing any words?</li><li>do you ever have difficulty speaking clearly?</li></ul>
Ability to speak <sup>(a)</sup>	<ul> <li>Thinking about problems with your teeth or mouth</li> <li>do you ever have difficulty pronouncing any words?</li> <li>do you ever have difficulty speaking clearly?</li> <li>do you have difficulty making yourself understood?</li> </ul>
Ability to speak <sup>(a)</sup>	<ul> <li>Thinking about problems with your teeth or mouth</li> <li>do you ever have difficulty pronouncing any words?</li> <li>do you ever have difficulty speaking clearly?</li> <li>do you have difficulty making yourself understood?</li> <li>Response format: yes/no</li> </ul>
Ability to speak <sup>(a)</sup> Oral and facial pain	<ul> <li>Thinking about problems with your teeth or mouth</li> <li>do you ever have difficulty pronouncing any words?</li> <li>do you ever have difficulty speaking clearly?</li> <li>do you have difficulty making yourself understood?</li> <li><i>Response format: yes/no</i></li> <li>In the last four weeks, have you had the following problems?</li> </ul>
Ability to speak <sup>(a)</sup> Oral and facial pain symptoms <sup>(a)</sup>	<ul> <li>Thinking about problems with your teeth or mouth</li> <li>do you ever have difficulty pronouncing any words?</li> <li>do you ever have difficulty speaking clearly?</li> <li>do you have difficulty making yourself understood?</li> <li><i>Response format: yes/no</i></li> <li>In the last four weeks, have you had the following problems?</li> <li>toothache</li> </ul>
Ability to speak <sup>(a)</sup> Oral and facial pain symptoms <sup>(a)</sup>	<ul> <li>Thinking about problems with your teeth or mouth</li> <li>do you ever have difficulty pronouncing any words?</li> <li>do you ever have difficulty speaking clearly?</li> <li>do you have difficulty making yourself understood?</li> <li><i>Response format: yes/no</i></li> <li>In the last four weeks, have you had the following problems?</li> <li>toothache</li> <li>pain in teeth with hot food or fluids</li> </ul>
Ability to speak <sup>(a)</sup> Oral and facial pain symptoms <sup>(a)</sup>	<ul> <li>Thinking about problems with your teeth or mouth</li> <li>do you ever have difficulty pronouncing any words?</li> <li>do you ever have difficulty speaking clearly?</li> <li>do you have difficulty making yourself understood?</li> <li><i>Response format: yes/no</i></li> <li>In the last four weeks, have you had the following problems?</li> <li>toothache</li> <li>pain in teeth with hot food or fluids</li> <li>pain in teeth with cold food or fluids</li> </ul>
Ability to speak <sup>(a)</sup> Oral and facial pain symptoms <sup>(a)</sup>	<ul> <li>Thinking about problems with your teeth or mouth</li> <li>do you ever have difficulty pronouncing any words?</li> <li>do you ever have difficulty speaking clearly?</li> <li>do you have difficulty making yourself understood?</li> <li><i>Response format: yes/no</i></li> <li>In the last four weeks, have you had the following problems?</li> <li>toothache</li> <li>pain in teeth with hot food or fluids</li> <li>pain in teeth with sweet food</li> </ul>
Ability to speak <sup>(a)</sup> Oral and facial pain symptoms <sup>(a)</sup>	<ul> <li>Thinking about problems with your teeth or mouth</li> <li>do you ever have difficulty pronouncing any words?</li> <li>do you ever have difficulty speaking clearly?</li> <li>do you have difficulty making yourself understood?</li> <li>Response format: yes/no</li> </ul> In the last four weeks, have you had the following problems? <ul> <li>toothache</li> <li>pain in teeth with hot food or fluids</li> <li>pain in teeth with sweet food</li> <li>pain in jaw while chewing</li> </ul>
Ability to speak <sup>(a)</sup> Oral and facial pain symptoms <sup>(a)</sup>	<ul> <li>Thinking about problems with your teeth or mouth</li> <li>do you ever have difficulty pronouncing any words?</li> <li>do you ever have difficulty speaking clearly?</li> <li>do you have difficulty making yourself understood?</li> <li><i>Response format: yes/no</i></li> <li>In the last four weeks, have you had the following problems?</li> <li>toothache</li> <li>pain in teeth with hot food or fluids</li> <li>pain in teeth with sweet food</li> <li>pain in jaw while chewing</li> <li>pain in jaw when opening mouth wide</li> </ul>
Ability to speak <sup>(a)</sup> Oral and facial pain symptoms <sup>(a)</sup>	<ul> <li>Thinking about problems with your teeth or mouth</li> <li>do you ever have difficulty pronouncing any words?</li> <li>do you ever have difficulty speaking clearly?</li> <li>do you have difficulty making yourself understood?</li> <li><i>Response format: yes/no</i></li> </ul> In the last four weeks, have you had the following problems? <ul> <li>toothache</li> <li>pain in teeth with hot food or fluids</li> <li>pain in teeth with sweet food</li> <li>pain in jaw while chewing</li> <li>pain in jaw when opening mouth wide</li> <li>pain in front of ear</li> </ul>
Ability to speak <sup>(a)</sup> Oral and facial pain symptoms <sup>(a)</sup>	<ul> <li>Thinking about problems with your teeth or mouth</li> <li>do you ever have difficulty pronouncing any words?</li> <li>do you ever have difficulty speaking clearly?</li> <li>do you have difficulty making yourself understood?</li> <li><i>Response format: yes/no</i></li> </ul> In the last four weeks, have you had the following problems? <ul> <li>toothache</li> <li>pain in teeth with hot food or fluids</li> <li>pain in teeth with cold food or fluids</li> <li>pain in teeth with sweet food</li> <li>pain in jaw while chewing</li> <li>pain in jaw when opening mouth wide</li> <li>pain in front of ear</li> <li>burning sensation in tongue or other parts of mouth</li> </ul>
Ability to speak <sup>(a)</sup> Oral and facial pain symptoms <sup>(a)</sup>	<ul> <li>Thinking about problems with your teeth or mouth</li> <li>do you ever have difficulty pronouncing any words?</li> <li>do you ever have difficulty speaking clearly?</li> <li>do you have difficulty making yourself understood?</li> <li><i>Response format: yes/no</i></li> </ul> In the last four weeks, have you had the following problems? <ul> <li>toothache</li> <li>pain in teeth with hot food or fluids</li> <li>pain in teeth with cold food or fluids</li> <li>pain in teeth with sweet food</li> <li>pain in jaw while chewing</li> <li>pain in jaw when opening mouth wide</li> <li>pain in front of ear</li> <li>burning sensation in tongue or other parts of mouth</li> <li>shooting pain in face or cheeks</li> </ul>
Ability to speak <sup>(a)</sup> Oral and facial pain symptoms <sup>(a)</sup>	<ul> <li>Thinking about problems with your teeth or mouth</li> <li>do you ever have difficulty pronouncing any words?</li> <li>do you ever have difficulty speaking clearly?</li> <li>do you have difficulty making yourself understood?</li> <li><i>Response format: yes/no</i></li> </ul> In the last four weeks, have you had the following problems? <ul> <li>toothache</li> <li>pain in teeth with hot food or fluids</li> <li>pain in teeth with cold food or fluids</li> <li>pain in teeth with sweet food</li> <li>pain in jaw while chewing</li> <li>pain in jaw when opening mouth wide</li> <li>pain in front of ear</li> <li>burning sensation in tongue or other parts of mouth</li> <li>shooting pain in face or cheeks</li> <li>pain or discomfort from denture</li> </ul>

Table 29: Potential predictors of urgency of dental care

(a) The variables described in 'Ability to chew', 'Ability to speak', 'Oral and facial pain symptoms', 'Other oral symptoms', 'Eating impact scale', 'Communication/social relations impact scale', 'Activities of daily living impact scale' and 'Worry/concern impact scale' are taken from Locker's battery of eight Subjective Oral Health Status Indicators (SOHSI) (Locker, 1997).

(continued)

Other oral symptoms <sup>†</sup>	In the last four weeks, have you had the following problems?
	mouth ulcers
	cold sores
	sore gums
	bleeding gums
	bad breath
	dryness of mouth
	unpleasant taste
	changes in ability to taste
	clicking/grating noise in jaw joint
	difficulty opening mouth wide
	Response format: yes/no
Eating impact scale <sup>(a)</sup>	Thinking about your dental health over the last year, how often
	have you been prevented from eating foods you would like to eat?
	<ul> <li>have you found your enjoyment of food less than it used to be?</li> </ul>
	<ul> <li>did it take you longer to finish a meal than other people?</li> </ul>
	Response format: all the time, very often, fairly often, sometimes, never
Communication/social	Thinking about your dental health over the last year, how often
relations impact scale <sup>(a)</sup>	<ul> <li>did you avoid eating with other people because of problems with chewing?</li> </ul>
	<ul> <li>were you embarrassed by the appearance or health of your teeth or mouth?</li> </ul>
	<ul> <li>did you avoid laughing or smiling?</li> </ul>
	<ul> <li>did you avoid conversations with others?</li> </ul>
	Response format: all the time, very often, fairly often, sometimes, never
Activities of daily living impact scale <sup>(a)</sup>	During the past year, how often have pain, discomfort or other problems with your teeth, mouth or dentures caused you to
	have difficulty sleeping?
	stay home more than usual?
	stay in bed more than usual?
	take time off work?
	be unable to do household chores?
	avoid usual leisure activities?
	Response format: all the time, very often, fairly often, sometimes, never
Worry/concern impact scale <sup>(a)</sup>	During the past year, how often have you worried about
	the appearance of your teeth or mouth?
	the health of your teeth or mouth?
	Response format: all the time, very often, fairly often, sometimes, never
Shortened OHIP	During the past year
Functional limitation scale	<ul> <li>have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?</li> </ul>
	<ul> <li>have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?</li> </ul>
Physical pain scale	<ul> <li>have you had a painful aching in your mouth?</li> </ul>
	<ul> <li>have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?</li> </ul>

Table 29: Potential predictors of urgency of dental care (continued)

(a) The variables described in 'Ability to chew', 'Ability to speak', 'Oral and facial pain symptoms', 'Other oral symptoms', 'Eating impact scale', 'Communication/social relations impact scale', 'Activities of daily living impact scale' and 'Worry/concern impact scale' are taken from Locker's battery of eight Subjective Oral Health Status Indicators (SOHSI) (Locker, 1997).

(continued)

	teeth, mouth or dentures
	<ul> <li>have you felt tense because of problems with your teeth, mouth or dentures?</li> </ul>
Physical disability scale	<ul> <li>has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?</li> </ul>
	<ul> <li>have you had to interrupt meals because of problems with your teeth, mouth or dentures?</li> </ul>
Psychological disability scale	<ul> <li>have you found it difficult to relax because of problems with your teeth, mouth or dentures?</li> </ul>
	<ul> <li>have you been a bit embarrassed because of problems with your teeth, mouth or dentures?</li> </ul>
Social disability scale	<ul> <li>have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?</li> </ul>
	<ul> <li>have you had difficulty doing your usual jobs because of problems with your teeth, mouth or dentures?</li> </ul>
Handicap scale	<ul> <li>have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?</li> </ul>
	<ul> <li>have you been totally unable to function because of problems with your teeth, mouth or dentures?</li> </ul>
	Response format: responses scored from 1 to 5 (i.e. from 'very often' to 'never')
Other symptoms	In the last four weeks, have you had the following problems?
	<ul> <li>pain which is worse in the middle of the day</li> </ul>
	pain at night
	swelling on gums
	swelling of your face or neck
	a lost filling
	a lost crown
	a broken filling
	a broken crown
	a loose tooth
	a cracked tooth
	high temperature
	Response format: yes/no
Other questions	Do you take any regular medication?
• • • • • • • • • • • • • • • • • • • •	<ul> <li>Do you have diabetes?</li> </ul>
	Do you smoke tobacco?
	Response format: yes/no
Dental anxiety	<ul> <li>Imagine you had an appointment to go to the dentist tomorrow, how would you feel about it?</li> </ul>
	<ul> <li>Imagine you are waiting in the dentist's waiting room for your turn in the chair, how would you feel?</li> </ul>
	<ul> <li>Imagine you are in the chair waiting while the dentist gets the drill ready to begin working on your teeth, how would you feel?</li> </ul>
	<ul> <li>Imagine you are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist is getting out the instruments to be used to scrape your teeth around the gums, how would you feel?</li> </ul>
	Response format: responses scored from 1 to 5

have you been self-conscious because of problems with your

#### Table 29: Potential predictors of urgency of dental care (continued)

•

Psychological discomfort scale

(a) The variables described in 'Ability to chew', 'Ability to speak', 'Oral and facial pain symptoms', 'Other oral symptoms', 'Eating impact scale', 'Communication/social relations impact scale', 'Activities of daily living impact scale' and 'Worry/concern impact scale' are taken from Locker's battery of eight Subjective Oral Health Status Indicators (SOHSI) (Locker, 1997).

# Distribution of responses to dependent and independent variables

## Dependent variable distribution – urgency of care

The percentage of respondents falling into each category of urgency of care, as determined by the assessing dentist, by state and total sample is shown in Table 30.

	SA	NSW	Total
	(n = 428)	(n = 259)	(n = 687)
	%	%	%
Urgency of care			
<1 month	7.5	25.5	14.3
1–3 months	18.2	37.5	25.5
4–6 months	15.9	23.2	18.6
7+ months	58.4	13.9	41.6

## Table 30: Percentage of respondents placed in categories of urgency of care

According to the assessing dentist, just over 14% of respondents required dental care within 1 month and a further 25.5% needed to be seen between 1 and 3 months. Almost 42% of respondents were classified in the '7+ months' category, suggesting that their dental treatment needs did not require immediate attention.

## Frequency of responses to independent variables

The percentage of respondents reporting 'yes' to various symptoms by state and overall sample is shown in Table 31. Patients were questioned about various problems they may have experienced in the last year.

## Table 31: Frequency of responses

	SA	NSW	Total	
	% within state	% within state	% within state	Sia.
Ability to show				9
Able to chew niece of fresh carrot	88.1	69 5	81.4	*
Able to chew boiled vegetables	94.3	96.6	95.1	ns
Able to chew fresh lettuce salad	94.0	97.0	95.1	n.s.
Able to chew firm food such as steak or dried apricots	89.6	73.9	83.9	*
Able to bite off and chew a piece of whole fresh apple	87.2	72.8	82.0	*
Able to chew hamburger	92.1	88.0	90.6	ns
Ability to speak	02.1	00.0	00.0	11.0.
Difficulty pronouncing any words	11 1	22.0	15.0	*
Difficulty speaking clearly	72	22.0	10.0	*
Difficulty making yourself understood	6.8	15.3	9.9	*
Oral and facial pain symptoms	0.0	10.0	0.0	
Tasthasha	25.0	60.1	447	*
Doin in tooth with cold food or fluido	30.9	60.1	44.7	*
Pain in teeth with bot food or fluids	30.9	45.0	44.7 22 5	*
Pain in teeth with hot lood of hulds	20.9	45.0	33.0 21.2	*
Pain in facth with sweet feed	14.0	34.0	21.3	*
Pain in front of ear	17.0	26.9	20.2	*
Shooting pain in face or cheeks	8.5	19.0	19.9	*
Pain in jaw when opening mouth wide	11.0	23.6	12.5	*
Burning sensation in tongue or other parts of mouth	2.8	10.9	5.7	*
Pain or discomfort from denture	5.3	10.5	8.0	*
Other and examples	0.0	12.7	0.0	
Other oral symptoms	21 E	44.0	26.2	*
Dryness of mouth	31.3	44.0	30.3 27.4	*
	21.3	30.Z	27.4	*
Plooding gume	24.3	30.0	29.7	*
Bad breath	29.0	J9.7 45 1	35.4	*
Difficulty opening mouth wide	23.4	43.1 23.6	15.6	*
Clicking/grating noise in jaw joint	16.2	25.0	19.6	*
Changes in ability to taste	7.5	16.3	10.7	*
Mouth ulcers	16.0	18.0	16.7	ns
Cold sores	10.0	16.9	12.5	*
Esting impact scale	10.0	10.0	12.0	
Prevented from eating foods you would like to eat	31.1	58 /	41.0	*
Have found oniovment of food loss than it used to be	21.0	16 F	41.0	*
Have found enjoyment of hood less than it used to be Has taken longer to finish a meal than other people	21.9	40.3 50 7	31.2	*
	20.0	50.7	51.2	
Avoided exting with other people	5.2	21.2	11 1	*
Embarrassed by appearance/health of teeth or mouth	3.3 35.7	21.2	11.1	*
Avoided loughing or smiling	26.1	48.0	43.4	*
Avoided conversations with others	20.1	40.0	10.8	*
	11.5	55.0	19.0	
Activities of daily living impact scale	24.0	50.4	22.0	*
Have difficulty sleeping	21.9	52.4	33.0	*
Stay home more than usual	5.5	20.0	13.9	*
Avoid usual leisure activities	J.7 2.4	27.9	13.0	*
Stav in had more than usual	3.4	10.2	0.0	*
Take time off work	2.3	7 1	7.0 2.0	*
	2.1	7.1	5.9	
	74.0	00.0	70.0	+
worry about nearth of teeth or mouth	(4.8	63.6	/9.0	*
wony about appearance of teeth or mouth	03.3	/ 5.8	8.10	

\* Statistically significant chi-square, P<0.05

n.s. Not statistically significant

(continued)

Table 31:	Frequency	of responses	(continued)
-----------	-----------	--------------	-------------

	SA	NSW	Total	
	% within state	% within state	% within state	Sig.
Shortened OHIP				
Trouble pronouncing words	8.9	27.1	15.5	*
Sense of taste worsened	11.7	29.4	18.1	*
Painful aching in mouth	40.6	69.0	50.9	*
Uncomfortable to eat any foods	36.9	70.6	49.2	*
Been self-conscious	38.2	61.3	46.6	*
Felt tense	23.4	53.2	34.2	*
Diet been unsatisfactory	11.7	34.9	20.1	*
Had to interrupt meals	13.0	47.2	25.4	*
Found it difficult to relax	20.6	50.7	31.5	*
Been a bit embarrassed	30.4	58.0	40.4	*
Been a bit irritable with other people	16.0	43.5	26.0	*
Had difficulty doing usual jobs	7.4	26.0	14.2	*
Felt that life in general was less satisfying	16.6	45.7	27.2	*
Been totally unable to function	5.9	21.6	11.6	*
Other symptoms				
Pain at night	12.3	30.7	19.0	*
A lost filling	11.7	24.0	16.1	*
A cracked tooth	5.3	17.7	9.8	*
A broken filling	8.3	24.1	14.0	*
A broken tooth from an accident	0.6	4.9	2.2	*
Swelling on gums	12.8	23.2	16.6	*
A loose tooth	5.1	15.0	8.7	*
A chipped tooth	11.9	27.7	17.7	*
Swelling of your face or neck	4.9	12.8	7.8	*
Pain which is worse in the middle of the day	4.5	15.7	8.5	*
High temperature	7.0	9.0	7.7	n.s.
A broken crown	1.7	4.5	2.7	*
A lost crown	0.9	4.9	2.3	*
Taking any regular medication	52.8	51.7	52.4	n.s.
Smokes tobacco	27.6	42.0	32.9	*
Diabetic	5.3	3.7	4.7	n.s.
Dental Anxiety Scale (DAS) score				
DAS score ≥13	10.0	22.3	14.5	*
DAS score <13	90.0	77.7	85.5	

\* Statistically significant chi-square, P<0.05

n.s. Not statistically significant

# Analyses

## Reliability analysis of scales

The internal reliability of each scale, i.e. that the items grouped within the scale measured the same concept, was tested using the Cronbach alpha test of inter-item reliability.

The Cronbach alpha values of the scales are shown in Table 32. For each scale,  $\alpha$  is above the level of 0.50 (which is recommended for inter-group comparisons), indicating adequate reliability for each of the scales.

Table 32:	Scale	reliabilit	v analvsis
I ubic 02.	ocure	1 CHuv Hit	y unuryono

Scale	Cronbach's alpha, $\alpha$
Ability to chew	0.8730
Ability to speak	0.8615
Oral and facial pain symptoms <sup>(a)</sup>	0.6906
Other oral symptoms	0.6814
Eating impact scale	0.8169
Communication/social relations impact scale	0.8436
Activities of daily living impact scale	0.8401
Worry/concern impact scale	0.8731
Shortened OHIP (total)	0.9252

(a) If remove 'Pain or discomfort from a denture',  $\alpha$  = 0.7702

## **Bivariate analyses**

An initial analysis of the data was carried out to determine if any of the potential predictor variables (see section 3.3) should be considered for use in a multivariate model. Bivariate associations between the potential predictor variables and urgency of care were therefore examined. The results are displayed in Table 33.

	Urgency of care (Per cent within urgency of care)							
Symptom	Response	<1 month	1–3 months	4–6 months	7+ months	Total		Sia.
Ability to chew								<u></u>
Chew fresh carrot	No	33.7	23.0	17.3	11.5	18.7	0.000	*
Chew boiled vegetables	No	6.1	6.3	1.6	4.5	4.7	0.229	n.s.
Chew fresh lettuce salad	No	7.1	4.6	3.1	4.6	4.7	0.563	n.s.
Chew firm foods	No	30.6	17.8	15.6	9.8	15.9	0.000	*
Bite off and chew a piece		31.6	18.9	17.3	11.5	17.3	0.000	*
of apple	No							
Chew hamburger	No	14.4	10.4	7.9	6.6	8.9	0.107	n.s.
Ability to speak								
Difficulty pronouncing								
words	Yes	23.5	20.1	10.2	11.5	15.2	0.003	*
Difficulty speaking clearly	Yes	17.3	16.2	10.9	9.5	12.6	0.076	n.s.
Difficulty being understood	Yes	13.3	15.0	7.8	7.4	10.2	0.034	*
Oral and facial pain sympto	ms							
Toothache	Yes	72.4	54.0	44.5	29.4	44.6	0.000	*
Pain in teeth with hot food or fluids	Yes	50.0	45.4	32.0	21.8	33.7	0.000	*
Pain in teeth with cold food								
or fluids	Yes	75.5	57.7	43.0	38.1	49.3	0.000	*
Pain in teeth with sweet	Vee	40.0	22.0	22.0	45.4	25.0	0.000	*
1000 Daia ia iau uchila ahau iaa	Yes	49.0	32.8	22.2	15.4	25.9	0.000	*
Pain in jaw while chewing	res	38.8	30.5	17.2	11.5	21.3	0.000	
Pain in jaw when open mouth wide	Yes	22.4	19.7	14 8	11.2	15.6	0 019	*
Pain in front of ear	Yes	29.6	27.0	19.5	12.9	20.1	0.000	*
Burning sensation in	103	20.0	21.0	10.0	12.0	20.1	0.000	
tongue/mouth	Yes	8.2	8.7	5.5	3.1	5.7	0.060	*
Shooting pain in face or								
cheeks	Yes	21.4	17.2	10.9	5.9	12.0	0.000	*
Pain or discomfort from	Vee	47.0	20.0	00 F	10.0	20.0	0.000	*
	res	47.0	39.0	29.5	18.9	29.9	0.023	
	Vee	47.0	47.0	10.0	45.0	40 F	0.004	
	res	17.3	17.0	18.8	15.0	10.5	0.804	n.s.
	Yes	13.3	17.1	14.1	10.5	13.2	0.248	n.s. *
Sore gums	Yes	37.8	36.0	21.1	21.0	27.2	0.000	- +
Bleeding gums	Yes	50.0	36.0	37.5	26.6	34.4	0.000	, +
Bad breath	Yes	48.0	45.1	35.9	24.8	35.3	0.000	- -
Dryness of mouth	Yes	40.8	42.8	36.7	30.1	36.1	0.032	, +
	Yes	41.8	36.0	29.7	20.3	29.1	0.000	- +
Changes in ability to taste	Yes	16.3	18.2	5.6	6.7	10.8	0.000	
Difficulty opening mouth wide	Yes	22.4	19.7	14.8	11.2	15.6	0.019	*
Clicking/grating noise in jaw joint	Yes	21.4	25.1	15.7	17.8	19.8	0.154	n.s.

Table 33:	Bivariate	associations	between	indepen	dent varia	ables and	urgency	of care
i ubic 00.	Divallate	abbottations	Detricent	macpen	aciit valit	ibico ulla	uigency	or cure

\* Statistically significant chi-square

n.s.Not statistically significant

(continued)

# Table 33: Bivariate associations between independent variables and urgency of care (continued)

Eating impact scale								
Have been prevented from	All the time	0.2	21	17	07	21	0 000	*
eating certain foods	Very often	.∠ 10.0	3.4 2 N	4.1 21	0. <i>1</i> 1 <i>1</i>	3.4 5.0	0.000	
	Offen	0.2	8.0	5.1	1.4	5.0		
	Somotimos	9.2 31.6	0.0 20.7	21.2	4.0	26.2		
	Nover	27.0	29.7	51.5	20.0	20.2		
Have found an inverse of	All the time	37.0	50.9	04.7 4 7	13.3	59.0	0.000	*
food less than it used to be	Vory often	12.2	J.7 7 /	4.7	2.5	4.1 5.4	0.000	
	Offen	0.2	7.4 5.7	5.5	2.5	5.4		
	Somotimos	9.2 10.4	3.1 22.2	20.2	2.0	17.2		
	Novor	19.4 51.0	58.0	20.3	12.J 91.1	68.2		
Has taken longer to finish a	All the time	24.5	14.4	12.2	22	10.2	0 000	*
meal than other people	All the time	24.5	6.2	13.3	3.2	10.9	0.000	
	Offen	0.1	0.3	2.3	3.Z 2.5	4.2		
	Somotimos	14.2	9.Z	117	2.5	10.0		
	Never	14.3	12.0 57.5	64.1	0.4	10.9		
		46.9	57.5	04.1	02.0	07.7		
Avoided exting with others								
Avoided eating with others	time/verv							
	often/often	16.3	9.1	4.7	1.8	6.3	0.000	
	Sometimes	6.1	9.1	7.8	0.7	5.0		
	Never	77.6	81.7	87.5	97.5	88.8		
Were embarrassed by	All the							
appearance or health of	time/very	15.0		<b>a</b> a (	10.0			
teeth or mouth	often/ often	45.9	33.9	28.1	12.6	25.7	0.000	
	Sometimes	13.3	19.0	22.7	16.8	18.0		
	Never	40.8	47.1	49.2	70.5	56.4		
Avoided laughing or	All the							
Sming	often/often	41.8	31.4	22.7	9.4	22.1	0.000	
	Sometimes	9.2	12.0	14.1	11.9	11.9		
	Never	49.0	56.6	63.3	78.7	65.9		
Avoided conversations with	All the							
others	time/very							
	often/often	22.4	19.5	8.6	3.1	11.1	0.000	
	Sometimes	11.2	9.8	10.9	6.6	8.9		
	Never	66.3	70.7	80.5	90.2	80.0		
Activities of daily living impa	act scale							
Have difficulty sleeping	Yes	68.4	39.4	36.7	16.8	33.6	0.000	
	Never	31.6	60.6	63.3	83.2	66.4		
Stay home more than	Yes	32.7	22.3	12.5	3.1	14.0	0.000	
usual	Never	67.3	77.7	87.5	96.9	86.0		
Stay in bed more than	Yes	15.3	13.1	7.0	1.7	7.6	0.000	
	Never	84.7	86.9	93.0	98.3	92.4		
Take time off work	Yes	28.6	8.5	7.1	2.8	7.8	0.000	
<b>D</b>	Never	/1.4	91.5	92.9	97.2	92.2	0.000	
Be unable to do household	Yes	20.4	12.6	8.6	2.5	8.7	0.000	
	Never	/9.6	87.4	91.4	97.5	91.3	0.000	
Avoid usual leisure	Yes	36.7	18.9	10.2	4.9	14.0	0.000	
	Never	63.3	81.1	89.8	95.1	86.0		

\* Statistically significant chi-square

(continued)

n.s.Not statistically significant

Worry about appearance of teeth or mouth         All the time Very often         34.7         18.3         16.4         7.7         15.9         0.000         *           Very often         14.3         11.4         7.8         4.2         8.2         *         *           Often         10.2         16.6         14.1         15.4         14.7         S.2         5         27.4         29.7         30.8         28.7         *           Worry about health of teeth or mouth         All the time         36.7         20.0         16.4         6.7         16.2         0.000         *           Very often         14.3         14.9         10.2         6.3         10.4         *         *         *         *         *           Often         12.2         24.0         19.5         20.8         20.1         * <t< th=""></t<>
teeth or mouth         Very often         14.3         11.4         7.8         4.2         8.2           Often         10.2         16.6         14.1         15.4         14.7           Sometimes         23.5         27.4         29.7         30.8         28.7           Worry about health of teeth or mouth         All the time         36.7         20.0         16.4         6.7         16.2         0.000         *           Very often         14.3         14.9         10.2         6.3         10.4         *         *           Often         12.2         24.0         19.5         20.8         20.1         *           Sometimes         25.5         26.9         34.4         37.3         32.4         *           Never         11.2         14.3         19.5         28.9         20.9         *           Other symptoms           Pain at night         Yes         31.6         22.7         16.4         8.0         16.7         0.000         *           Swelling on gums         Yes         11.2         0.6         2.3         0.7         2.5         0.000         *           A lost filling         Yes         31.6
Often         10.2         16.6         14.1         15.4         14.7           Sometimes         23.5         27.4         29.7         30.8         28.7           Worry about health of teeth or mouth         All the time         36.7         20.0         16.4         6.7         16.2         0.000         *           Very often         14.3         14.9         10.2         6.3         10.4         *         *           Often         12.2         24.0         19.5         20.8         20.1         *         *           Sometimes         25.5         26.9         34.4         37.3         32.4         *           Pain worse in the middle of the day         Yes         21.6         10.9         7.0         3.5         8.6         0.000         *           Swelling on gums         Yes         31.6         22.7         16.4         8.0         16.7         0.000         *           Swelling of face or neck         Yes         11.2         0.6         2.3         0.7         2.5         0.000         *           A lost filling         Yes         31.6         22.7         16.4         8.0         16.7         0.000         *
Sometimes or mouth         23.5         27.4         29.7         30.8         28.7           Worry about health of teeth or mouth         All the time         36.7         20.0         16.4         6.7         16.2         0.000         *           Very often         14.3         14.9         10.2         6.3         10.4         *         *           Often         12.2         24.0         19.5         20.8         20.1         *           Sometimes         25.5         26.9         34.4         37.3         32.4         *           Pain worse in the middle of the day         Yes         21.6         10.9         7.0         3.5         8.6         0.000         *           Swelling on gums         Yes         31.6         22.7         16.4         8.0         16.7         0.000         *           Swelling of face or neck         Yes         11.2         0.6         2.3         0.7         2.5         0.000         *           A lost filling         Yes         31.6         22.7         16.4         8.0         16.7         0.000         *           A lost filling         Yes         11.2         0.6         2.3         0.7         2.5
Worry about health of teeth or mouth         Never         17.3         26.3         32.0         42.0         32.6           Worry about health of teeth or mouth         All the time         36.7         20.0         16.4         6.7         16.2         0.000         *           Very often         14.3         14.9         10.2         6.3         10.4         *           Often         12.2         24.0         19.5         20.8         20.1         *           Sometimes         25.5         26.9         34.4         37.3         32.4         *           Pain worse in the middle of the day         Yes         21.6         10.9         7.0         3.5         8.6         0.000         *           Swelling on gums         Yes         31.6         22.7         16.4         8.0         16.7         0.000         *           Swelling of face or neck         Yes         14.3         10.0         5.5         4.9         7.6         0.010         *           A lost filling         Yes         17.6         25.6         13.3         7.0         15.8         0.000         *           A lost crown         Yes         11.2         0.6         2.3         0.7
Worry about health of teeth or mouth         All the time         36.7         20.0         16.4         6.7         16.2         0.000         *           Very often         14.3         14.9         10.2         6.3         10.4         *         *           Often         12.2         24.0         19.5         20.8         20.1         *         *           Sometimes         25.5         26.9         34.4         37.3         32.4         *         *           Never         11.2         14.3         19.5         28.9         20.9         *         *           Pain worse in the middle of the day         Yes         21.6         10.9         7.0         3.5         8.6         0.000         *           Swelling on gums         Yes         31.6         22.7         16.4         8.0         16.7         0.000         *           Swelling of face or neck         Yes         14.3         10.0         5.5         4.9         7.6         0.010         *           A lost filling         Yes         27.6         25.6         13.3         7.0         15.8         0.000         *           A lost crown         Yes         9.2         0.6
or mouth         Very often         14.3         14.9         10.2         6.3         10.4           Often         12.2         24.0         19.5         20.8         20.1           Sometimes         25.5         26.9         34.4         37.3         32.4           Never         11.2         14.3         19.5         28.9         20.9           Other symptoms         Pain worse in the middle of the day         Yes         21.6         10.9         7.0         3.5         8.6         0.000         *           Pain worse in the middle of the day         Yes         21.6         10.9         7.0         3.5         8.6         0.000         *           Swelling on gums         Yes         31.6         22.7         16.4         8.0         16.7         0.000         *           Swelling of face or neck         Yes         14.3         10.0         5.5         4.9         7.6         0.010         *           A lost filling         Yes         11.2         0.6         2.3         0.7         2.5         0.000         *           A lost crown         Yes         11.2         0.6         2.3         0.7         2.5         0.000         *
Offen         12.2         24.0         19.5         20.8         20.1           Sometimes         25.5         26.9         34.4         37.3         32.4           Never         11.2         14.3         19.5         28.9         20.9           Other symptoms         Pain worse in the middle of the day         Yes         21.6         10.9         7.0         3.5         8.6         0.000         *           Pain at night         Yes         21.6         10.9         7.0         3.5         8.6         0.000         *           Swelling on gums         Yes         31.6         22.7         16.4         8.0         16.7         0.000         *           Swelling of face or neck         Yes         14.3         10.0         5.5         4.9         7.6         0.010         *           A lost filling         Yes         27.6         25.6         13.3         7.0         15.8         0.000         *           A lost crown         Yes         11.2         0.6         2.3         0.7         2.5         0.000         *           A broken filling         Yes         9.2         0.6         2.3         2.4         2.9         0.001
Sometimes         25.5         26.9         34.4         37.3         32.4           Never         11.2         14.3         19.5         28.9         20.9           Other symptoms         Pain worse in the middle of the day         Yes         21.6         10.9         7.0         3.5         8.6         0.000         *           Pain at night         Yes         21.6         10.9         7.0         3.5         8.6         0.000         *           Swelling on gums         Yes         31.6         22.7         16.4         8.0         16.7         0.000         *           Swelling of face or neck         Yes         14.3         10.0         5.5         4.9         7.6         0.010         *           A lost filling         Yes         27.6         25.6         13.3         7.0         15.8         0.000         *           A lost crown         Yes         11.2         0.6         2.3         0.7         2.5         0.000         *           A lost crown         Yes         9.2         0.6         2.3         0.7         2.5         0.000         *           A loose tooth         Yes         17.5         14.0         10.9
Never         11.2         14.3         19.5         28.9         20.9           Other symptoms         Pain worse in the middle of the day         Yes         21.6         10.9         7.0         3.5         8.6         0.000         *           Pain at night         Yes         21.6         10.9         7.0         3.5         8.6         0.000         *           Swelling on gums         Yes         38.8         27.6         12.5         9.8         19.0         0.000         *           Swelling on gums         Yes         31.6         22.7         16.4         8.0         16.7         0.000         *           Swelling of face or neck         Yes         14.3         10.0         5.5         4.9         7.6         0.010         *           A lost filling         Yes         27.6         25.6         13.3         7.0         15.8         0.000         *           A lost crown         Yes         11.2         0.6         2.3         0.7         2.5         0.000         *           A broken filling         Yes         9.2         0.6         2.3         2.4         2.9         0.001         *           A loose tooth         Yes
Other symptoms           Pain worse in the middle of the day         Yes         21.6         10.9         7.0         3.5         8.6         0.000         *           Pain at night         Yes         38.8         27.6         12.5         9.8         19.0         0.000         *           Swelling on gums         Yes         31.6         22.7         16.4         8.0         16.7         0.000         *           Swelling of face or neck         Yes         14.3         10.0         5.5         4.9         7.6         0.010         *           A lost filling         Yes         27.6         25.6         13.3         7.0         15.8         0.000         *           A lost crown         Yes         11.2         0.6         2.3         0.7         2.5         0.000         *           A broken filling         Yes         9.2         0.6         2.3         2.4         2.9         0.001         *           A loose tooth         Yes         17.5         14.0         10.9         1.7         8.8         0.000         *           A loose tooth         Yes         35.1         16.9         19.5         11.5         17.7
Pain worse in the middle of the day       Yes       21.6       10.9       7.0       3.5       8.6       0.000       *         Pain at night       Yes       38.8       27.6       12.5       9.8       19.0       0.000       *         Swelling on gums       Yes       31.6       22.7       16.4       8.0       16.7       0.000       *         Swelling of face or neck       Yes       14.3       10.0       5.5       4.9       7.6       0.010       *         A lost filling       Yes       27.6       25.6       13.3       7.0       15.8       0.000       *         A lost filling       Yes       11.2       0.6       2.3       0.7       2.5       0.000       *         A broken filling       Yes       30.6       17.0       13.3       6.3       13.8       0.000       *         A broken crown       Yes       9.2       0.6       2.3       2.4       2.9       0.001       *         A loose tooth       Yes       17.5       14.0       10.9       1.7       8.8       0.000       *         A chipped tooth       Yes       35.1       16.9       19.5       11.5       17.7 <td< td=""></td<>
the day       Yes       21.6       10.9       7.0       3.5       8.6       0.000       *         Pain at night       Yes       38.8       27.6       12.5       9.8       19.0       0.000       *         Swelling on gums       Yes       31.6       22.7       16.4       8.0       16.7       0.000       *         Swelling of face or neck       Yes       14.3       10.0       5.5       4.9       7.6       0.010       *         A lost filling       Yes       27.6       25.6       13.3       7.0       15.8       0.000       *         A lost filling       Yes       11.2       0.6       2.3       0.7       2.5       0.000       *         A boken filling       Yes       30.6       17.0       13.3       6.3       13.8       0.000       *         A broken crown       Yes       9.2       0.6       2.3       2.4       2.9       0.001       *         A loose tooth       Yes       17.5       14.0       10.9       1.7       8.8       0.000       *         A chipped tooth       Yes       35.1       16.9       19.5       11.5       17.7       0.000       *
Pain at night       Yes       38.8       27.6       12.5       9.8       19.0       0.000       *         Swelling on gums       Yes       31.6       22.7       16.4       8.0       16.7       0.000       *         Swelling of face or neck       Yes       14.3       10.0       5.5       4.9       7.6       0.010       *         A lost filling       Yes       27.6       25.6       13.3       7.0       15.8       0.000       *         A lost filling       Yes       11.2       0.6       2.3       0.7       2.5       0.000       *         A broken filling       Yes       30.6       17.0       13.3       6.3       13.8       0.000       *         A broken crown       Yes       9.2       0.6       2.3       2.4       2.9       0.001       *         A loose tooth       Yes       17.5       14.0       10.9       1.7       8.8       0.000       *         A chipped tooth       Yes       35.1       16.9       19.5       11.5       17.7       0.000       *         A broken tooth from an       Yes       25.5       12.3       5.5       5.2       10.0       0.000
Swelling on gums         Yes         31.6         22.7         16.4         8.0         16.7         0.000         *           Swelling of face or neck         Yes         14.3         10.0         5.5         4.9         7.6         0.010         *           A lost filling         Yes         27.6         25.6         13.3         7.0         15.8         0.000         *           A lost crown         Yes         11.2         0.6         2.3         0.7         2.5         0.000         *           A broken filling         Yes         30.6         17.0         13.3         6.3         13.8         0.000         *           A broken crown         Yes         9.2         0.6         2.3         2.4         2.9         0.001         *           A loose tooth         Yes         17.5         14.0         10.9         1.7         8.8         0.000         *           A chipped tooth         Yes         35.1         16.9         19.5         11.5         17.7         0.000         *           A broken tooth from an         Yes         25.5         12.3         5.5         5.2         10.0         0.0000         *
Swelling of face or neck         Yes         14.3         10.0         5.5         4.9         7.6         0.010         *           A lost filling         Yes         27.6         25.6         13.3         7.0         15.8         0.000         *           A lost crown         Yes         11.2         0.6         2.3         0.7         2.5         0.000         *           A broken filling         Yes         30.6         17.0         13.3         6.3         13.8         0.000         *           A broken crown         Yes         9.2         0.6         2.3         2.4         2.9         0.001         *           A loose tooth         Yes         17.5         14.0         10.9         1.7         8.8         0.000         *           A chipped tooth         Yes         35.1         16.9         19.5         11.5         17.7         0.000         *           A broken tooth from an         Yes         25.5         12.3         5.5         5.2         10.0         0.000         *
A lost filling       Yes       27.6       25.6       13.3       7.0       15.8       0.000       *         A lost crown       Yes       11.2       0.6       2.3       0.7       2.5       0.000       *         A broken filling       Yes       30.6       17.0       13.3       6.3       13.8       0.000       *         A broken crown       Yes       9.2       0.6       2.3       2.4       2.9       0.001       *         A loose tooth       Yes       17.5       14.0       10.9       1.7       8.8       0.000       *         A chipped tooth       Yes       35.1       16.9       19.5       11.5       17.7       0.000       *         A broken tooth from an       Yes       25.5       12.3       5.5       5.2       10.0       0.000       *
A lost crown       Yes       11.2       0.6       2.3       0.7       2.5       0.000       *         A broken filling       Yes       30.6       17.0       13.3       6.3       13.8       0.000       *         A broken crown       Yes       9.2       0.6       2.3       2.4       2.9       0.001       *         A loose tooth       Yes       17.5       14.0       10.9       1.7       8.8       0.000       *         A chipped tooth       Yes       35.1       16.9       19.5       11.5       17.7       0.000       *         A cracked tooth       Yes       25.5       12.3       5.5       5.2       10.0       0.000       *         A broken tooth from an       Yes       44       25       0.9       4.0       2.0       0.000       *
A broken filling         Yes         30.6         17.0         13.3         6.3         13.8         0.000         *           A broken crown         Yes         9.2         0.6         2.3         2.4         2.9         0.001         *           A loose tooth         Yes         17.5         14.0         10.9         1.7         8.8         0.000         *           A chipped tooth         Yes         35.1         16.9         19.5         11.5         17.7         0.000         *           A broken tooth         Yes         25.5         12.3         5.5         5.2         10.0         0.000         *
A broken crown         Yes         9.2         0.6         2.3         2.4         2.9         0.001         *           A loose tooth         Yes         17.5         14.0         10.9         1.7         8.8         0.000         *           A chipped tooth         Yes         35.1         16.9         19.5         11.5         17.7         0.000         *           A cracked tooth         Yes         25.5         12.3         5.5         5.2         10.0         0.000         *
A loose tooth         Yes         17.5         14.0         10.9         1.7         8.8         0.000         *           A chipped tooth         Yes         35.1         16.9         19.5         11.5         17.7         0.000         *           A cracked tooth         Yes         25.5         12.3         5.5         5.2         10.0         0.000         *           A broken tooth from an excitation         Yes         4.4         2.5         0.0         4.0         2.0         0.000         *
A chipped tooth         Yes         35.1         16.9         19.5         11.5         17.7         0.000         *           A cracked tooth         Yes         25.5         12.3         5.5         5.2         10.0         0.000         *           A broken tooth from an excitation         Yes         24.4         25.5         0.00         *
A cracked tooth         Yes         25.5         12.3         5.5         5.2         10.0         0.000         *           A broken tooth from an excitation         4.4         2.5         0.2         0.000         *
A broken tooth from an
accident Yes 4.1 3.5 0.8 1.0 2.0 0.099 h.s.
High temperature         Yes         8.2         11.0         6.3         5.6         7.5         0.172         n.s.
Shortened OHIP
Trouble pronouncing words Yes 26.5 21.7 14.8 8.4 15.6 0.000 *
Sense of taste worsened Yes 35.7 26.9 15.6 8.4 18.4 0.000 *
Painful aching in mouth Yes 75.5 66.9 51.2 34.6 51.7 0.000 *
Uncomfortable to eat any
foods Yes 69.4 63.4 53.1 33.2 49.8 0.000 *
Have been self-conscious         Yes         72.4         56.0         52.3         30.5         47.1         0.000         *
Felt tense         Yes         54.1         44.0         40.6         18.9         34.4         0.000         *
Diet has been
unsatisfactory Yes 37.8 29.7 21.1 8.0 20.2 0.000 *
Have had to interrupt
means         Yes         48.0         35.4         28.1         11.2         25.8         0.000         *           Differentiate relevance         C2.2         C2.4         C2.0         40.4         C2.0         0.000         *
Difficult to relax Yes 63.3 39.4 33.9 16.4 32.2 0.000
Been a bit embarrassed Yes 62.2 49.1 46.9 25.5 40.8 0.000 *
Been a bit irritable with others Ves 45.4 33.1 34.4 12.6 26.5 0.000 *
Difficulty doing usual jobs Ves 27.6 21.7 14.1 5.2 14.3 0.000 *
Life in general has been
less satisfying Yes 49.0 37.1 29.7 12.9 27.4 0.000 *
Totally unable to function Yes 22.4 17.7 10.9 4.9 11.8 0.000 *
Other questions
Smoker Yes 45.9 41.1 28.9 24.1 32.5 0.000 *
Taking any regular
medication Yes 51.0 48.0 62.5 51.9 52.8 0.084 n.s.
Diabetic         Yes         2.0         4.0         4.7         5.6         4.5         0.518         n.s.

# Table 33: Bivariate associations between independent variables and urgency of care (continued)

\* Statistically significant chi-square

n.s.Not statistically significant

(continued)

Sociodemographic variables								
Age group	18–24 years	10.3	3.4	7.0	12.3	8.8	0.001	*
	25-44 years	51.5	47.1	34.4	37.5	41.4		
	45–64 years	26.8	31.0	29.7	26.0	28.1		
	65+ years	11.3	18.4	28.9	24.2	21.8		
Maximum education	Primary	6.2	6.3	7.8	6.3	6.6	0.390	n.s.
	Some secondary	39.2	32.0	27.3	32.2	32.2		
	Completed secondary	28.9	26.9	30.5	24.1	26.7		
	Some university	5.2	5.1	6.3	9.8	7.3		
	Completed university	10.3	9.1	6.3	6.3	7.6		
	Some TAFE	5.2	6.3	6.3	8.4	7.0		
	Completed TAFE	5.2	12.0	12.5	12.2	11.2		
	Other	_	2.3	3.1	0.7	1.5		
Usual/previous occupation	Manager/professional	10.5	11.8	11.3	11.7	11.5	0.035	*
	Para-professional/trade	11.6	15.9	27.4	24.9	21.1		
	Clerk/sales/driver/labourer	57.9	51.2	40.3	43.6	47.0		
	Self-employed	_	2.4	2.4	1.1	1.5		
	Home duties	11.6	13.5	9.7	7.7	10.1		
	Other	8.4	5.3	8.9	11.0	8.8		
Sex of patient	Female	65.3	48.0	54.7	59.8	57.6	0.131	n.s.
	Male	34.7	52.0	45.3	40.2	42.4		
Language mainly spoken at home	English	82.7	81.1	82.8	87.1	84.1	0.342	n.s.
	Other	17.3	18.9	17.2	12.9	15.9		
Country of birth	Australia	61.2	55.7	54.7	57.3	57.0	0.773	n.s.
	Other	38.8	44.3	45.3	42.7	43.0		
Dental Anxiety Scale (DAS) score	DAS score <13	73.5	87.4	82.8	89.9	85.6	0.001	*
	DAS score ≥13	26.5	12.6	17.2	10.1	14.4		
Dental visiting factors								
Usual reason for dental visit	Check-up	8.2	28.2	28.9	54.4	36.5	0.000	*
	Problem	87.6	69.4	67.2	40.0	59.3		
	Check-up/problem	4.1	2.4	3.9	5.6	4.3		
Time since last dental visit	<12 months	51.0	40.8	45.7	23.9	36.1	0.000	*
	1–<2 years	14.3	16.1	16.5	21.4	18.1		
	2-<3 years	8.2	13.8	10.2	16.8	13.6		
	3-<5 years	13.3	11.5	12.6	18.6	14.9		
	5+ years	13.3	17.2	15.0	19.3	17.1		
	Never	0.0	0.6	0.00	0.0	0.1		
Place of last dental visit	Private practice	24.5	30.1	25.2	39.9	32.4	0.046	*
	Public hospital/clinic	73.5	64.7	64.6	50.9	60.2		
	School dental service	2.0	3.5	7.9	7.8	5.9		
	Other	0.0	1.7	2.4	1.4	1.5		
Frequency of dental visits	>2 times a year	8.2	5.8	3.1	5.6	5.6	0.069	n.s.
	2 times a year	6.2	6.9	9.4	7.4	7.5		
	Once a year	15.5	12.7	14.2	17.6	15.4		
	Once every 2 years	19.6	27.2	32.3	32.4	29.2		
	Once every 5 years	26.8	20.2	18.9	23.6	22.3		
	< Once every 5 years	23.7	27.2	22.0	13.4	20.0		

Table 33: Bivariate associations between independent variables and urgency of care (continued)

\* Statistically significant chi-square

n.s. Not statistically significant

Bivariate associations between the subjective oral health status and OHIP scales and the urgency of care were also examined. The results are presented in Table 34.

The 'Oral and facial pain symptoms' and 'Other oral symptoms' scales are a 10-item scale with 'yes' and 'no' response options whereby 'yes' is represented by 1 and 'no' by 0. Adding the responses to each item yields a total score ranging from 0 to 10. Zero represents no oral and facial pain symptoms or any other oral symptoms, while 10 represents high experience of oral and facial pain symptoms and other oral symptoms. The 'Ability to chew' and 'Ability to speak' scales are 6-item and 3-item scales respectively. The mean number of oral symptoms for each urgency of care category is presented in Table 34.

The 'Activities of daily living scale' and 'Worry/concern impact scale' consisted of five and two items respectively. Responses to each item were made on a Likert-type scale whereby respondents were asked to indicate their level of experience with each of the items in question. The response format was a 5-point scale (scored from 1 to 5) ranging from 'all the time' to 'never'. The mean score for each item by category of urgency of care is presented in Table 34.

		Urgency of care						Sig.
		<1	1–3	4–6	7+			
Scale		month	months	months	months	Total		
Ability to chew	Valid n	98	175	128	286	687	0.000	***
('yes' responses)	Mean	4.76	5.17	5.35	5.51	5.28		
	Std Dev.	1.79	1.55	1.31	1.33	1.48		
Ability to chew	Valid n	98	175	128	286	687	0.000	***
('no' responses)	Mean	1.24	0.83	0.65	0.49	0.72		
	Std Dev.	1.79	1.55	1.31	1.33	1.48		
Ability to speak	Valid n	98	175	128	286	687	0.008	***
	Mean	0.54	0.51	0.29	0.28	0.38		
	Std Dev.	0.99	1.04	0.73	0.78	0.88		
Eating impact scale	Valid n	98	175	128	285	686	0.000	***
	Mean	3.74	4.10	4.26	4.66	4.31		
	Std Dev.	1.26	1.07	1.02	0.65	1.00		
Communication/social	Valid n	98	175	128	286	687	0.000	***
relations impact scale	Mean	3.82	4.16	4.36	4.69	4.37		
	Std Dev.	1.27	1.07	0.89	0.69	0.98		
Oral and facial pain	Valid n	98	175	128	286	687	0.000	***
symptoms	Mean	3.78	3.02	2.20	1.54	2.36		
	Std Dev.	2.20	2.44	2.03	1.78	2.23		
Other oral symptoms	Valid n	98	175	128	286	687	0.000	***
	Mean	3.09	2.88	2.30	1.84	2.37		
	Std Dev.	2.13	2.54	1.93	1.78	2.13		
Activities of daily living	Valid n	98	175	128	284	685	0.000	***
impact scale	Mean	4.51	4.67	4.82	4.91	4.77		
	Std Dev.	0.57	0.63	0.32	0.29	0.47		
Worry/concern impact scale	Valid n	98	175	128	284	685	0.000	***
	Mean	2.67	3.16	3.42	3.86	3.43		
	Std Dev.	1.45	1.30	1.32	1.07	1.30		
OHIP (total)	Valid n	98	175	128	286	687	0.000	***
. ,	Mean	3.76	4.06	4.29	4.65	4.31		
	Std Dev.	0.95	0.89	0.77	0.54	0.82		
Functional limitation scale	Valid n	98	175	128	285	686	0.000	***
	Mean	4.32	4.43	4.71	4.82	4.63		
	Std Dev.	0.93	0.96	0.61	0.55	0.77		
Physical pain scale	Valid n	98	175	127	286	686	0.000	***
	Mean	3.13	3.41	3.86	4.30	3.82		
	Std Dev.	1.26	1.20	1.08	0.95	1.18		
Psychological discomfort	Valid n	98	175	128	285	686	0.000	***
scale	Mean	3.22	3.67	3.85	4.44	3.96		
	Std Dev.	1.40	1.37	1.28	0.90	1.26		
Physical disability scale	Valid n	98	175	128	286	687	0.000	***
	Mean	3.92	4.23	4.48	4.80	4.47		
	Std Dev.	1.28	1.10	0.91	0.60	0.97		
Psychological disability	Valid n	98	175	127	286	686	0.000	***
scale	Mean	3.43	3.94	4.09	4.56	4.15		
	Std Dev.	1.26	1.16	1.07	0.78	1.09		
Social disability scale	Valid n	97	175	128	286	686	0.000	***
-	Mean	4.20	4.37	4.51	4.83	4.56		
	Std Dev.	1.04	1.03	0.83	0.54	0.86		
Handicap scale	Valid n	98	175	128	286	687	0.000	***
-	Mean	4.13	4.37	4.58	4.81	4.56		
	Std Dev.	1.10	1.01	0.77	0.56	0.86		

\*\*\* Statistically significant ANOVA

A number of variables had a significant association with urgency of care and are marked by asterisks. Significant variables from the bivariate analyses will be further examined by means of logistic regression so as to develop a prediction model for urgency of care.

## Logistic regression

4 = 7 + months

To further examine factors associated with the urgency of care, logistic regression analysis was performed using a range of predictor variables. Predictor variables with a significant bivariate association with urgency of care (see section 3.4) were entered in a binary logistic regression in order to determine the strengths of the independent association of these variables. These predictor variables included patient characteristics (e.g. age, sex), subjective oral health status indicators (e.g. experience of pain or other oral symptoms) and oral health impact profile (OHIP) scale.

Note: Although occupation has a significant association with urgency of care, it will not be included in the models since relative need should really be determined by reported symptoms and should not be influenced by the socioeconomic characteristics of the patient.

For the purpose of this analysis, urgency of care has been dichotomised (since the outcome variable in a logistic regression is binary or dichotomous) and two logistic regression models will be fitted, one for each of the new urgency of care variables:

#### Urgency of care New urgency of care 1 = <1 month Model 1 2 = 1 - 3 months 3 = 4-6 months

Model 2 1 = <6 months</th>1 =  $\leq$ 3 months0 = 7+ months0 = 7+ months

## Model 1: New urgency of care = ≤6 months or 7+ months

Of the variables and scales with a statistically significant bivariate association with urgency of care, four were significant in the binary logistic regression. The logistic regression coefficients were used to estimate odds ratios for each of the independent variables in the model. The coefficients and odds ratios for urgency of care are presented in Table 35.

The odds ratio indicated that persons who experienced oral and facial pain symptoms were 1.2 times more likely to require treatment within 6 months compared to those who did not have these symptoms.

Persons who reported higher OHIP scores were less likely to require general care within 6 months than those who reported lower scores (N.B. responses to each item in the OHIP scale were made on a 5-point Likert scale, scored from 1 to 5, whereby a score of 1 represents high experience of symptoms while 5 represents no experience of symptoms).

Those who reported a problem as their usual reason for visiting the dentist had 2.3 times the odds of requiring general dental treatment within 6 months compared to those who reported a check-up as their usual reason for visiting the dentist.

Time since last visit was also a significant predictor of urgency of care in the logistic model. It was found that persons who last visited a dentist 12 months ago were 2.0 times the odds of requiring general dental care within 6 months compared to those who last visited 3 or more years ago. (Note that those who last visited a dentist 12 months ago would have visited for emergency care since the inclusion criteria for the general RNI sample states that patients should not have visited the dentist for routine dental care in the last year).

Variable	В	S.E.	P-value	OR	Lower	Upper	Sig.
Oral and facial pain symptoms	0.147	0.052	0.004	1.158	1.047	1.282	*
Shortened OHIP	-0.727	0.163	0.000	0.483	0.351	0.666	*
Usual reason for dental visit			0.000				*
Check-up	REF.						
Problem	0.837	0.193	0.000	2.309	1.581	3.373	*
Check-up/problem	-0.158	0.444	0.722	0.854	0.357	2.040	
Time since last dental visit			0.005				*
<12 months	0.688	0.217	0.001	1.990	1.302	3.042	*
1–<3 years	0.193	0.215	0.370	1.213	0.796	1.848	
3+ years	REF.						
Smoker							
Yes/occasionally	-0.329	0.196	0.094	0.720	0.490	1.058	n.s.
No	REF.						
Model constant	3.006	0.872	0.001	20.202			

Table 35: Logistic regression coefficients for model 1

Analysis used n = 678 cases with complete data on all variables

REF. Reference category for odds ratio

\* Statistically significant

n.s. Not statistically significant

In terms of the logistic regression equation, the results in Table 35 can be represented as followed:

P('urgent') = 
$$\frac{1}{1 + e^{-(b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5)}}$$

(see Table 36 for interpretation of values in this equation).

i	Independent variable	Response value (x <sub>i</sub> )	Beta coefficient (b <sub>i</sub> )	SE
0	Model constant		3.006	0.872
1	Oral and facial pain symptoms	Continuous variable, values range (calculate a score)	0.147	0.052
2	Shortened OHIP	Continuous variable, values range (calculate a score)	-0.727	0.163
		1 = Check-up <sup>†</sup>	0.837	0.193
3	Usual reason for dental visit	2 = Problem	-0.158	0.444
		3 = Check-up/ problem		
		1 = <12 months	0.688	0.217
4	Time since last dental visit	2 = 1–<3 years	0.193	0.215
		$3 = 3 + years^{\dagger}$		
	Quarkan	1 = Yes	-0.329	0.196
5	Smoker	$0 = No^{\dagger}$		

 Table 36: Independent predictor variables for Model 1: response values, logistic regression beta coefficients and standard errors

† Reference category

Since the results of logistic regression analysis are in terms of probability of a particular outcome (e.g. needing to be seen within 6 months), the cut-off value chosen for assignment to a category is critical in evaluating the success of the model.

## Model 2: New urgency of care = ≤3 months or 4+ months

Of the variables and scales with a statistically significant bivariate association with urgency of care, seven were significant in the binary logistic regression. The logistic regression coefficients were used to estimate odds ratios for each of the independent variables in the model. The coefficients and odds ratios for urgency of care are presented in Table 36.

The odds ratio indicated that persons who experienced oral and facial pain symptoms were 1.2 times more likely to require treatment within 3 months compared to those who did not have these symptoms.

Persons who reported higher OHIP scores were less likely to require general care within 3 months than those who reported lower scores (N.B. responses to each item in the OHIP scale were made on a 5-point Likert scale, scored from 1 to 5, whereby a score of 1 represents high experience of symptoms while 5 represents no experience of symptoms).

Those who reported a problem as their usual reason for visiting the dentist were 1.7 times more likely to require general dental treatment within 3 months compared to those who reported a check-up as their usual reason for visiting the dentist.

People who last visited a SDS clinic or other clinic (not private) were less likely to require care within 3 months compared to people who last visited a public dental clinic.

Experience of a lost filling and loose tooth were also significant predictors of urgency of care in the logistic model. In fact, those who reported having a lost filling or loose

tooth in the last four weeks had just over 2.0 times the odds of requiring care within 3 months compared to those who did not report these symptoms.

Lastly, smokers had 1.8 times the odds of requiring general dental care within 3 months compared to non-smokers.

Variable	В	S.E.	P-value	OR	Lower	Upper	Sig.
Oral and facial pain symptoms	0.169	0.049	0.001	1.184	1.074	1.304	*
Shortened OHIP	-0.457	0.138	0.001	0.633	0.483	0.830	*
Usual reason for dental visit			0.020				*
Check-up	REF.						
Problem	0.514	0.207	0.013	1.671	1.114	2.509	*
Check-up/problem	-0.260	0.505	0.606	0.771	0.287	2.073	
Place of last dental visit			0.029				*
Private practice	-0.324	0.195	0.096	0.723	0.493	1.059	
Public hospital/clinic	REF.	0.415	0.020	0.381	0.169	0.860	*
SDS/other	-0.964						
Lost filling							
Yes	0.734	0.251	0.003	2.084	1.274	3.408	*
No	REF.						
Loose tooth							
Yes	0.710	0.328	0.030	2.033	1.069	3.866	*
No	REF.						
Smoker							
Yes	0.592	0.192	0.002	1.808	1.241	2.634	*
No	REF.						
Model constant	0.586	0.700	0.403	1.796			

Table 37: Logistic regression coefficients for model 2

Analysis used n = 669 cases with complete data on all variables

REF. Reference category for odds ratio

Statistically significant

n.s. Not statistically significant

In terms of the logistic regression equation, the results in the Table 37 can be represented as followed:

P('urgent') = 
$$\frac{1}{1 + e^{-(b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 + b_7 x_7)}}$$

(see Table 38 for interpretation of values in this equation).

i	Independent variable	Response value (x <sub>i</sub> )	Beta coefficient (b <sub>i</sub> )	SE
0	Model constant		0.586	0.700
1	Oral and facial pain symptoms	Continuous variable, values range (calculate a score)	0.169	0.049
2	Shortened OHIP	Continuous variable, values range (calculate a score)	-0.457	0.138
		1 = Check-up <sup>†</sup>		
3	Usual reason for dental visit	2 = Problem	0.514	0.207
		3 = Check-up/ problem	-0.260	0.505
		1 = Private practice	-0.324	0.195
4	Place of last dental visit	2 = Public hospital/ clinic <sup>†</sup>		
		3 = SDS/other	-0.964	0.415
5	A loot filling	1=Yes	0.734	0.251
	A lost ming	0=No <sup>†</sup>		
6		1=Yes	0.710	0.328
	A loose tooth	0=No <sup>†</sup>		
7	<u>Creation</u>	1=Yes	0.592	0.192
1	Smoker	0=No <sup>†</sup>		

 Table 38: Independent predictor variables for Model 2: response values, logistic regression beta coefficients and standard errors

† Reference category

## **ROC curves**

## ROC curve for general model 1

The ROC curve for general model 1 examining urgency of  $\leq 6$  months vs 7+ months is shown in Figure 6 The cut-off values on the curve represent the probability of needing treatment within 6 months.



## ROC curve for general model 2

The ROC curve for general model 2 is shown in Figure 7.



## Results – diagnostic test indicators

## General model 1

Sensitivity, specificity, positive predictive values (PV+) and negative predictive values (PV-) calculated for general model 1 at varying cut-off values are presented in Table 39.

Cut-off	Sensitivity	Specificity	PV+	PV-
0.2	1.00	0.004	0.58	1.00
0.3	0.94	0.27	0.64	0.77
0.4	0.85	0.46	0.69	0.68
0.5	0.77	0.63	0.74	0.66
0.57	0. 71	0.73	0.78	0.64
0.6	0.67	0.76	0.80	0.63
0.7	0.51	0.87	0.84	0.56
0.8	0.34	0.94	0.88	0.50
0.9	0.15	0.98	0.92	0.46

Table 39: Sensitivity, specificity and predictive values for general model 1

As can be seen from Table 39, as the cut-off value is lowered, the sensitivity increases but the specificity decreases. Hence, fewer false negative results are obtained but the proportion of false positive test results increases. The opposite is true when higher cut-off values are selected.

Suppose a low cut-off value of 0.3 is selected. Of the patients who actually require care within 6 months, 94% will have positive test results. This is the percentage of 'true positive' results. The remaining 6% of patients requiring care within 6 months have negative test results but are nonetheless in need of care within the 6 months timeframe. This is the percentage of patients with 'false negative' test results, i.e. 6% of patients in need of dental care within 6 months will be misclassified as able to wait 7 or more months for treatment.

Of the patients who are not urgent i.e. can wait 7 or more months for treatment, 27% will have negative test results. This is the percentage of 'true negative' results. The remaining 73% of non-urgent patients have positive test results but are not urgent. This is the percentage of patients with 'false positive' test results i.e. 73% of patients who are able to wait 7 or more months for treatment will be misclassified and receive care within 6 months.

If the test is positive, the probability of being urgent is 64% (i.e. a positive predictive value of 64% means that 64 of 100 patients with positive test results will likely require care within 6 months). Hence, there is a 36% chance that the patient is not urgent. If the test is negative, the probability of needing care within 6 months is 23%, which indicates a 77% chance that the patient is not urgent.

## Example interpretation of general model 1

Suppose there are 100 patients presenting for general dental care. According to the assessing dentist, approximately 58% require care within 6 months and a further 42% are able to wait a longer period of 7 or more months for treatment (see Table 29).

Consider what happens to these 100 patients when a cut-off point of 0.3 is selected.

Decision	1:	cut-off	=	0.3
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Cut-off	Sensitivity	Specificity	PV+	PV-
0.3	0.94	0.27	0.64	0.77

Using a cut-off value of 0.3, the model sensitivity is 94%. The specificity is 27%, indicating that of those 58 patients actually requiring care within 6 months, 55 (94%) will be correctly identified as more urgent and will therefore be seen within 6 months, but 3 patients (6%) will be misclassified and receive care in 7 or more months time (i.e. patients end up with false negative results).

Of the 42 patients who are considered able to wait 7 or more months for treatment, 11 (27%) without urgent need will actually test negative but 31 (73%) will be misclassified (i.e. 31 patients end up with false positive results) and receive care within 6 months.

These results are summarised in Table 40.

Table 40: Example using general model 1 with cut-off = 0.3 to assign priority to 100 patients presenting for general dental care

		Clinician urgency (clinical assessment of urgency)		
		≤6 months (+ve)	7+ months (-ve)	Total
Test result	≤6 months +ve	55	31 (FP)	86
(based on predictor variables)	7+ months -ve	3 (FN)	11	14
	Total	58	42	100

FP = false positive, FN = false negative

Similar calculations can be made for the other cut-off values (see Appendix B1).

## General model 2

Sensitivity, specificity, positive predictive values (PV+) and negative predictive values (PV-) calculated for general model 2 at varying cut-off values are presented in Table 41.

Cut-off	Sensitivity	Specificity	PV+	PV-
0.1	1.00	0.03	0.40	0.93
0.2	0.92	0.32	0.47	0.86
0.3	0.78	0.58	0.55	0.80
0.4	0.63	0.74	0.61	0.76
0.5	0.50	0.85	0.68	0.73
0.6	0.40	0.92	0.76	0.70
0.7	0.27	0.96	0.82	0.67
0.8	0.16	0.99	0.88	0.65
0.9	0.05	1.00	0.92	0.62

Table 41: Sensitivity, specificity and predictive values for general model 2

Suppose, for example, a cut-off value of 0.5 is chosen. The test is 50% sensitive, meaning that 50% of urgent patients test positive and 50% are potentially misclassified (i.e. 50% of urgent people will be missed). Specificity for the test is 85%, meaning that 85% of non-urgent patients test negative (i.e. 15% of non-urgent patients will be
misclassified as urgent). If the test is positive, the probability of being urgent is 68%, but there is a 32% chance that the patient is not urgent. If the test is negative, the probability of being urgent is 27%, which indicates a 73% chance that the patient is not urgent.

# Example interpretation of general model 2

Suppose there are 100 patients presenting for general dental care. According to the assessing dentist, approximately 40% require care within 3 months (i.e. 14.3% require care within 1 month and 25.5% require care in 1–3 months) and the remaining 60% are considered able to wait 4 or more months for dental care (i.e. 18.6% are classified as requiring care in 4–6 months and 60.2% are considered able to wait 7+ months for treatment) (see Table 29).

The way in which general model 2 classifies these 100 patients into the two treatment urgency categories, namely  $\leq$ 3 months or 4+ months, depends upon the cut-off value selected. To illustrate how the model classifies these patients, suppose a cut-off value of 0.5 is used.

#### **Decision 1: cut-off = 0.5**

Cut-off	Sensitivity	Specificity	PV+	PV-
0.5	0.50	0.85	0.68	0.73

Of those 40 patients actually requiring care within 3 months, 20 (50%) will be correctly identified as more urgent and will therefore be seen within 3 months, but 20 patients will be misclassified and receive care in 4 or more months time (i.e. 20 patients end up with false negative results).

Of the 60 patients who are considered able to wait 4 or more months for treatment, 51 (85%) without urgent need will actually test negative but 9 (15%) will be misclassified (i.e. 9 patients end up with false positive results) and receive care within 3 months.

These results are summarised in Table 42.

Table 42: Example using general model 2 with cut-off = 0.5 to assign priority to 100 patients presenting for general dental care

		Clinician ur clinical assessmer)	gency It of urgency)	
		≤3 months (+ve)	4+ months (-ve)	Total
Test result	≤3 months +ve	20	9 (FP)	29
(based on predictor variables)	4+ months -ve	20 (FN)	51	71
	Total	40	60	100

FP = false positive, FN = false negative

Similar calculations can be made for the other cut-off values (see Appendix B1).

# References

Corah NL (1969) Development of a dental anxiety scale. Journal of Dental Research 48, 596.

Fletcher RH, Fletcher SW and Wagner EH (1996) Clinical Epidemiology: The Essentials, 3rd edn. Baltimore: Williams and Wilkins.

Locker D (1997) Subjective oral health status indicators. In: Measuring oral health and quality of life; Ed. Slade GD pp105–112. Chapel Hill: University of North Carolina, Dental Ecology.

# Appendix A1: Emergency model results using various cut-off values

Additional 2x2 tables for various cut-off values for each emergency model are included in this section.

#### **Emergency model 1**

#### 1. cut-off = 0.3, sensitivity = 0.73, specificity = 0.61

		Clinician urge (clinical assessment o	ncy of urgency)	
		<48 hours (+ve)	2+days (-ve)	Total
Test result	<48 hours +ve	26	25 (FP)	51
(based on predictor variables)	2+ days -ve	10 (FN)	39	49
	Total	36	64	100

#### 2. $cut-off = 0.4^{(a)}$ , sensitivity = 0.58, specificity = 0.77

		Clinician urger (clinical assessment c	ncy of urgency)	
		<48 hours (+ve)	2+days (-ve)	Total
Test result	<48 hours +ve	21	15 (FP)	36
(based on predictor variables)	2+ days -ve	15 (FN)	49	64
	Total	36	64	100

(a) This particular cut-off point produces test results which are consistent with the clinician's assessment of urgency.

#### 3. cut-off = 0.5, sensitivity = 0.45, specificity = 0.88

		Clinician urge clinical assessment d	ncy of urgency)	
		<48 hours (+ve)	2+days (-ve)	Total
Test result (based on predictor variables)	<48 hours +ve	16	8 (FP)	24
	2+ days -ve	20 (FN)	56	76
	Total	36	64	100

#### 4. cut-off = 0.6, sensitivity = 0.30, specificity = 0.94

		Clinician urger (clinical assessment c	ncy of urgency)	
		<48 hours (+ve)	2+days (-ve)	Total
Test result	<48 hours +ve	11	4 (FP)	15
(based on predictor variables)	2+ days -ve	25 (FN)	60	85
	Total	36	64	100

#### **Emergency model 2**

Assuming cut-off = 0.2 for emergency model 1:

# 1. cut-off = 0.2, sensitivity = 0.97, specificity = 0.12, PV+ = 0.56, PV- = 0.79

		Clinician ur clinical assessmer)	gency it of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result	2–7 days +ve	13	12 (FP)	25
(based on predictor variables)	8+ days -ve	0 (FN)	2	2
	Total	13	14	27

# 2. cut-off = 0.3, sensitivity = 0.91, specificity = 0.35, PV+ = 0.62, PV- = 0.76

		Clinician urger (clinical assessment o	icy f urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result	2–7 days +ve	14	8 (FP)	22
(based on predictor variables)	8+ days -ve	1 (FN)	4	5
	Total	15	12	27

#### 3. cut-off = 0.4, sensitivity = 0.84, specificity = 0.49, PV+ = 0.66, PV- = 0.73

		Clinician urge (clinical assessment d	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result	2–7 days +ve	12	7 (FP)	19
(based on predictor variables)	8+ days -ve	2 (FN)	6	18
	Total	14	13	27

# 4. cut-off = 0.5, sensitivity = 0.75, specificity = 0.65, PV+ = 0.71, PV- = 0.69

		Clinician urger (clinical assessment c	ncy of urgency)	
	-	2–7 days (+ve)	8+ days (-ve)	Total
Test result	2–7 days +ve	11	4 (FP)	15
(based on predictor variables)	8+ days -ve	4 (FN)	8	12
	Total	15	12	27

		Clinician urge clinical assessment)	ency of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result	2–7 days +ve	10	3 (FP)	13
(based on predictor variables)	8+ days -ve	5 (FN)	9	14
	Total	14	13	27

		Clinician urge (clinical assessment o	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result	2–7 days +ve	9	3 (FP)	12
(based on predictor variables)	8+ days -ve	5 (FN)	10	15
	Total	14	13	27

# 7. cut-off = 0.7, sensitivity = 0.44, specificity = 0.90, PV+ = 0.84, PV- = 0.58

		Clinician urger (clinical assessment c	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	7	1 (FP)	8
	8+ days -ve	8 (FN)	11	19
	Total	15	12	27

#### Assuming cut-off = 0.3 for emergency model 1:

		Clinician urgency (clinical assessment of urgency)		
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	24	21 (FP)	45
	8+ days -ve	1 (FN)	3	4
	Total	25	24	49

# 1. cut-off = 0.2, sensitivity = 0.97, specificity = 0.12, PV+ = 0.56, PV- = 0.79

#### 2. cut-off = 0.3, sensitivity = 0.91, specificity = 0.35, PV+ = 0.62, PV- = 0.76

		Clinician urger (clinical assessment c	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result	2–7 days +ve	25	14 (FP)	39
(based on predictor variables)	8+ days -ve	2 (FN)	8	10
	Total	27	22	49

#### 3. cut-off = 0.4, sensitivity = 0.84, specificity = 0.49, PV+ = 0.66, PV- = 0.73

		Clinician urge (clinical assessment d	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	22	12 (FP)	34
	8+ days -ve	4 (FN)	11	15
	Total	26	23	49

# 4. cut-off = 0.5, sensitivity = 0.75, specificity = 0.65, PV+ = 0.71, PV- = 0.69

		Clinician urge (clinical assessment	ency of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	20	8 (FP)	28
	8+ days -ve	6 (FN)	15	21
	Total	26	23	49

		Clinician urg (clinical assessmen	gency t of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	17	7 (FP)	24
	8+ days -ve	9 (FN)	16	25
	Total	26	23	49

		Clinician urger (clinical assessment c	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	17	5 (FP)	22
	8+ days -ve	10 (FN)	17	27
	Total	27	22	49

# 7. cut-off = 0.7, sensitivity = 0.44, specificity = 0.90, PV+ = 0.84, PV- = 0.58

		Clinician urger (clinical assessment c	ncy f urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	12	2 (FP)	14
	8+ days -ve	15 (FN)	20	35
	Total	27	22	49

#### Assuming cut-off = 0.4 for emergency model 1:

		Clinician urge clinical assessment d	Clinician urgency (clinical assessment of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	32	27 (FP)	59
	8+ days -ve	1 (FN)	4	5
	Total	33	31	64

#### 1. cut-off = 0.2, sensitivity = 0.97, specificity = 0.12, PV+ = 0.56, PV- = 0.79

#### 2. cut-off = 0.3, sensitivity = 0.91, specificity = 0.35, PV+ = 0.62, PV- = 0.76

		Clinician urger (clinical assessment c	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result	2–7 days +ve	32	19 (FP)	51
(based on predictor variables)	8+ days -ve	3 (FN)	10	13
	Total	35	29	64

#### 3. cut-off = 0.4, sensitivity = 0.84, specificity = 0.49, PV+ = 0.66, PV- = 0.73

		Clinician urg (clinical assessment	ency t of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	29	15 (FP)	44
	8+ days -ve	5 (FN)	15	20
	Total	34	30	64

#### 4. cut-off = 0.5<sup>(b)</sup>, sensitivity = 0.75, specificity = 0.65, PV+ = 0.71, PV- = 0.69

		Clinician urger (clinical assessment o	ncy f urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result	2–7 days +ve	26	10 (FP)	36
(based on predictor variables)	8+ days -ve	9 (FN)	19	28
	Total	35	29	64

(b) This particular cut-off point produces test results which are reasonably consistent with the clinician's assessment of urgency.

		Clinician urg (clinical assessment	ency t of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	23	9 (FP)	32
	8+ days -ve	11 (FN)	21	32
	Total	34	30	64

		Clinician urger (clinical assessment o	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	22	7 (FP)	29
	8+ days -ve	13 (FN)	22	35
	Total	35	29	64

# 7. cut-off = 0.7, sensitivity = 0.44, specificity = 0.90, PV+ = 0.84, PV- = 0.58

		Clinician urger (clinical assessment o	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	15	3 (FP)	18
	8+ days -ve	19 (FN)	27	46
	Total	34	30	64

#### Assuming cut-off = 0.5 for emergency model 1:

		Clinician urge clinical assessment d	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	38	32 (FP)	70
	8+ days -ve	1 (FN)	5	6
	Total	39	37	76

# 1. cut-off = 0.2, sensitivity = 0.97, specificity = 0.12, PV+ = 0.56, PV- = 0.79

#### 2. cut-off = 0.3, sensitivity = 0.91, specificity = 0.35, PV+ = 0.62, PV- = 0.76

		Clinician urge (clinical assessment d	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	38	22 (FP)	60
	8+ days -ve	4 (FN)	12	16
	Total	42	34	76

#### 3. cut-off = 0.4, sensitivity = 0.84, specificity = 0.49, PV+ = 0.66, PV- = 0.73

		Clinician urge (clinical assessment d	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	34	18 (FP)	52
	8+ days -ve	6 (FN)	18	24
	Total	40	36	76

# 4. cut-off = 0.5, sensitivity = 0.75, specificity = 0.65, PV+ = 0.71, PV- = 0.69

		Clinician urge (clinical assessment	ency of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	31	12 (FP)	43
	8+ days -ve	10 (FN)	23	33
	Total	41	35	76

		Clinician urg (clinical assessment	ency of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result	2–7 days +ve	28	10 (FP)	38
(based on predictor variables)	8+ days -ve	13 (FN)	25	38
	Total	41	35	76

		Clinician urger (clinical assessment c	ncy of urgency)	
	-	2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	26	8 (FP)	34
	8+ days -ve	15 (FN)	27	42
	Total	41	35	76

# 7. cut-off = 0.7, sensitivity = 0.44, specificity = 0.90, PV+ = 0.84, PV- = 0.58

		Clinician urge (clinical assessment o	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result	2–7 days +ve	18	4 (FP)	21
(based on predictor variables)	8+ days -ve	23 (FN)	32	55
	Total	41	35	76

#### Assuming cut-off = 0.6 for emergency model 1:

		Clinician urger clinical assessment d	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	43	36 (FP)	79
	8+ days -ve	1 (FN)	5	6
	Total	44	41	85

# 1. cut-off = 0.2, sensitivity = 0.97, specificity = 0.12, PV+ = 0.56, PV- = 0.79

#### 2. cut-off = 0.3, sensitivity = 0.91, specificity = 0.35, PV+ = 0.62, PV- = 0.76

		Clinician urge (clinical assessment d	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	43	25 (FP)	67
	8+ days -ve	4 (FN)	13	18
	Total	47	38	85

#### 3. cut-off = 0.4, sensitivity = 0.84, specificity = 0.49, PV+ = 0.66, PV- = 0.73

		Clinician urg (clinical assessment	ency t of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	38	20 (FP)	58
	8+ days -ve	7 (FN)	20	27
	Total	45	40	85

# 4. cut-off = 0.5, sensitivity = 0.75, specificity = 0.65, PV+ = 0.71, PV- = 0.69

		Clinician urge (clinical assessment d	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	34	14 (FP)	48
	8+ days -ve	12 (FN)	25	37
	Total	46	39	85

		Clinician urge (clinical assessment	ency of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	31	11 (FP)	42
	8+ days -ve	15 (FN)	28	43
	Total	46	39	85

		Clinician urger (clinical assessment c	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	29	9 (FP)	38
	8+ days -ve	17 (FN)	30	47
	Total	46	39	85

# 7. cut-off = 0.7, sensitivity = 0.44, specificity = 0.90, PV+ = 0.84, PV- = 0.58

		Clinician urger (clinical assessment c	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	20	4 (FP)	24
	8+ days -ve	26 (FN)	35	61
	Total	46	39	85

#### Assuming cut-off = 0.7 for emergency model 1:

		Clinician urger clinical assessment d	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	46	40 (FP)	86
	8+ days -ve	2 (FN)	5	7
	Total	48	45	93

# 1. cut-off = 0.2, sensitivity = 0.97, specificity = 0.12, PV+ = 0.56, PV- = 0.79

#### 2. cut-off = 0.3, sensitivity = 0.91, specificity = 0.35, PV+ = 0.62, PV- = 0.76

		Clinician urger (clinical assessment c	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	47	27 (FP)	74
	8+ days -ve	4 (FN)_	15	19
	Total	51	42	93

#### 3. cut-off = 0.4, sensitivity = 0.84, specificity = 0.49, PV+ = 0.66, PV- = 0.73

		Clinician urge (clinical assessment o	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	41	23 (FP)	64
	8+ days -ve	8 (FN)	21	29
	Total	49	44	93

# 4. cut-off = 0.5, sensitivity = 0.75, specificity = 0.65, PV+ = 0.71, PV- = 0.69

		Clinician urge (clinical assessment	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	38	15 (FP)	53
	8+ days -ve	12 (FN)	28	40
	Total	50	43	93

		Clinician urge (clinical assessment	ency of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	34	12 (FP)	46
	8+ days -ve	16 (FN)	31	47
	Total	50	43	93

		Clinician urger (clinical assessment c	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	31	10 (FP)	41
	8+ days -ve	19 (FN)	33	52
	Total	50	43	93

# 7. cut-off = 0.7, sensitivity = 0.44, specificity = 0.90, PV+ = 0.84, PV- = 0.58

		Clinician urger (clinical assessment c	ncy of urgency)	
		2–7 days (+ve)	8+ days (-ve)	Total
Test result (based on predictor variables)	2–7 days +ve	22	4 (FP)	26
	8+ days -ve	28 (FN)	39	67
	Total	50	43	93

# **Emergency model 3**

		Clinician urgency (clinical assessment of urgency)		
		≤7 days (+ve)	8+ days (-ve)	Total
Test result	≤7 days +ve	71	29 (FP)	100
(based on predictor variables)	8+ days -ve	0 (FN)	0	0
	Total	71	29	100

# 1. cut-off = 0.2, sensitivity = 1.00, specificity = 0.00

# 2. cut-off = 0.3, sensitivity = 0.99, specificity = 0.04

		Clinician urgency (clinical assessment of urgency)		
	_	≤7 days (+ve)	8+ days (-ve)	Total
Test result	≤7 days +ve	70	28 (FP)	98
(based on predictor variables)	8+ days -ve	1 (FN)	1	2
	Total	71	29	100

# 3. cut-off = 0.4, sensitivity = 0.93, specificity = 0.24

		Clinician urgency (clinical assessment of urgency)		
	_	≤7 days (+ve)	8+ days (-ve)	Total
Test result	≤7 days +ve	66	22 (FP)	88
(based on predictor variables)	8+ days -ve	5 (FN)	7	12
	Total	71	29	100

# 4. cut-off = 0.5, sensitivity = 0.89, specificity = 0.40

		Clinician urgency (clinical assessment of urgency)		
		≤7 days (+ve)	8+ days (-ve)	Total
Test result	≤7 days +ve	63	17 (FP)	80
(based on predictor variables)	8+ days -ve	8 (FN)	12	20
	Total	71	29	100

# 5. cut-off = 0.7, sensitivity = 0.66, specificity = 0.73

		Clinician urgency (clinical assessment of urgency)		
		≤7 days (+ve)	8+ days (-ve)	Total
Test result	≤7 days +ve	47	8 (FP)	55
(based on predictor variables)	8+ days -ve	24 (FN)	21	45
	Total	71	29	100

6.	cut-off = 0.8	3, sensitivity =	• 0.49, s	pecificity $= 0.8$	7
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		Clinician urgency (clinical assessment of urgency)		
		≤7 days (+ve)	8+ days (-ve)	Total
Test result	≤7 days +ve	34	4	39
(based on predictor variables)	8+ days -ve	36 (FN)	25	61
	Total	71	29	100

# 7. cut-off = 0.9, sensitivity = 0.49, specificity = 0.87

		Clinician urgency (clinical assessment of urgency)		
	-	≤7 days (+ve)	8+ days (-ve)	Total
Test result	≤7 days +ve	18	1 (FP)	19
(based on predictor variables)	8+ days -ve	53 (FN)	28	81
	Total	71	29	100

# Appendix A2: Screening questions from emergency models

These are the series of questions identified to assist in discriminating between those able to wait longer than 1 week, those who should be seen within 2–7 days and those who should be seen within 48 hours. Note that the responses given in the 'Response' boxes are only an example.

#### **Emergency models 1 and 2**

	Response
In the last week, have you had	
<ul> <li>pain in teeth with cold food or fluids</li> </ul>	Yes
<ul> <li>pain in jaw when opening mouth wide</li> </ul>	Yes
<ul> <li>shooting pain in face or cheeks</li> </ul>	No
<ul> <li>bleeding gums</li> </ul>	No
• a broken filling	No
• a loose tooth	No
• a toothache	Yes
<ul> <li>pain in teeth with hot food/fluids</li> </ul>	No
<ul> <li>pain which is worse in the middle of the day</li> </ul>	No
During the last week, how often has pain, discomfort or other	
problems with your teeth, mouth or dentures caused you to have	
<ul> <li>difficulty sleeping</li> </ul>	Very often
During the last week, how often have you	
worried about the health of your teeth or mouth	Very often
<ul> <li>worried about the appearance of your teeth or mouth</li> </ul>	Sometimes
Dental Anxiety Scale (DAS)	
<ul> <li>Imagine you had an appointment to go to the dentist tomorrow, how would you feel about it?</li> </ul>	I would be a little uneasy about it
<ul> <li>Imagine you are waiting in the dentist's waiting room for your turn in the chair, how would you feel?</li> </ul>	A little uneasy
<ul> <li>Imagine you are in the chair waiting while the dentist gets the drill ready to begin working on your teeth, how would you feel?</li> </ul>	Tense
<ul> <li>Imagine you are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist is getting out the instruments to be used to scrape your teeth around the gums, how would you feel?</li> </ul>	A little uneasy
URGENCY: <48 hours	

Note: If a patient gave these responses to the questions it is predicted that they would require care within 48 hours (based on a cut-off value of 0.5 – modifying the cut-off value may change the urgency prediction).

It is suggested that the questions identified for emergency models 1 and 2 be combined so that all the questions are asked of patients when they ring up for an emergency appointment. One of the benefits of this approach is that patients will not be able to memorise questions or give what they believe are desirable responses to ensure receiving care sooner, since there are too many response permutations to the 16 questions. Also, care is determined based on the pattern of responses so there would be too many response combinations for the patient to consider.

# **Emergency model 3**

	Response
In the last week, have you had…	
a toothache	No
<ul> <li>pain which is worse in the middle of the day</li> </ul>	No
<ul> <li>shooting pain in face or cheeks</li> </ul>	No
sore gums	No
bleeding gums	No
<ul> <li>changes in ability to taste</li> </ul>	No
<ul> <li>a broken filling</li> </ul>	No
a loose tooth	No
<ul> <li>your teeth, mouth or dentures caused you to have</li> <li>difficulty sleeping</li> </ul>	Never
	L
During the last week, how often have you…	
<ul> <li>worried about the appearance of your teeth or mouth</li> </ul>	Never
URGENCY: 8+ days	

Note: Responding 'No' or 'Never' to all the above questions places the patient in the urgency category of 8+ days (based on a cut-off value of 0.5 – modifying the cut-off value may change the urgency prediction).

# Appendix A3: Emergency dental care questionnaire



	RESPONSES RECORDED MUST BE THOSE OF THE PATIENT.
1	Please indicate your date of birth:
	■ sex: Male 1 Female 2
2	Were you born in Australia? Yes 1 No 2
	If No, (a) in what country were you born?
	(b) in which year did you first arrive in Australia to live?
3	Are you of Aboriginal and/or Torres Strait Islander origin?       No       Image: constraint islander         Yes, Aboriginal       Image: constraint islander       Image: constraint islander         Yes, Torres Strait Islander       Image: constraint islander       Image: constraint islander
4	What is the postcode of the suburb/area you live in?
5	Which language do you <i>mainly</i> speak at home? ( <i>Please tick one box</i> )
5	Which language do you mainly speak at home? (Please tick one box)         English      1         Mandarin      6
5	Which language do you mainly speak at home? (Please tick one box)         English       1       Mandarin       6         Italian       2       Arabic       7         Oracle       0       Duracian       0
5	Which language do you mainly speak at home? (Please tick one box)         English       1       Mandarin       6         Italian       2       Arabic       7         Greek       3       Russian       8         Cantopece       Corman       0
5	Which language do you mainly speak at home? (Please tick one box)         English       1       Mandarin       6         Italian       2       Arabic       7         Greek       3       Russian       8         Cantonese       4       German       9         Vietnamese       5       Other (please specify)       10
5	Which language do you mainly speak at home? (Please tick one box)         English       1       Mandarin       6         Italian       2       Arabic       7         Greek       3       Russian       8         Cantonese       4       German       9         Vietnamese       5       Other (please specify)       10
5	Which language do you mainly speak at home? (Please tick one box)         English       1       Mandarin       6         Italian       2       Arabic       7         Greek       3       Russian       8         Cantonese       4       German       9         Vietnamese       5       Other (please specify)       10         Australia's population is made up of many ethnic communities or groups.       With which community or group do you mainly identify?

7	How old were you when you left school? (Please tick one box)
•	Did not go to school
	14 years or younger
	15 years
	16 years
	17 years
	18 years
	19 years or older
8	What is the highest level of education you have attained? (Please tick one box)
	Primary School
	Some secondary school
	Completed secondary school
	Some University, higher education
	Completed a University, higher education course
	Some TAFE, CAE or vocational course
	Completed TAFE, CAE or vocational course
	Other
	Don't know
9	(a) Do you have
	Pensioner concession card (full entitlement)?
	Pensioner concession card (part entitlement)?
	Health care card?
	Veterans Affairs Card?
	Commonwealth Seniors Health Card?
	(b) How long have you had your concession card?
	Pensioner concession card (full entitlement)
	Health care card
	Veterans Affairs card
	Commonwealth Seniors Health card
10	(a) Do you have private dental insurance? Yes $\Box_1 \longrightarrow Go to (b)$
	No $\square_2 \longrightarrow$ Go to Q11
	Q10 continued on next page

	Less than 6 months 6 months to less than 12 months 1 year to less than 2 years	$ \begin{array}{c}         1 & 2 \\         2 & 3 \\         3 & 5         \end{array} $	years to les years to les years or m	ss than 3 ye ss than 5 ye ore	ears ears	4 5 6	
11	In the last week, what dental problem has Toothache Broken/lost filling Broken tooth Need a filling Bleeding gum/teeth Stead tooth extracted 7 Swelling	caused you to s Sore gums Ulcer/s Accident/incid Loose dentur Broken dentur Need new de Headache Other ( <i>please</i>	seek dental dent re/s ure/s enture/s e specify)	care?		9 10 11 12 13 14 15 16	
	<ul> <li>In the last week, have you had the following</li> <li>(a) toothache</li> <li>(b) pain in teeth with hot foods or fluids</li> <li>(c) pain in teeth with cold foods or fluids</li> <li>(d) pain in teeth with sweet foods</li> <li>(d) pain in jaw while chewing</li> <li>(e) pain in jaw when opening mouth wide</li> <li>(f) pain in jaw when opening mouth wide</li> <li>(g) pain which is worse in the middle of the system of the syste</li></ul>	ig problems?	Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes		No No No No No No No	$ \begin{array}{c}             2^2 \\             2^2 \\           $	NA 🔲 3

				_		_	
	(a)	mouth ulcers	Yes		No	2	
	(b)	cold sores	Yes		No	<b></b> 2	
	(c)	sore gums	Yes		No	2	
	(d)	bleeding gums	Yes	<b>1</b>	No	2	
	(e)	swelling on gums	Yes		No	2	
	(f)	bad breath	Yes		No	2	
	(g)	dryness of mouth	Yes	1	No	2	
	(h)	unpleasant taste	Yes	1	No	2	
	(i)	changes in ability to taste	Yes		No	2	
	(j)	clicking/grating noise in jaw joint	Yes		No	2	
	(k)	swelling of your face or neck	Yes	<b>1</b>	No	2	
	(I)	a lost filling	Yes	<b>1</b>	No	2	
	(m)	a lost crown	Yes	<b>1</b>	No	2	
	(n)	a broken filling	Yes	<b>1</b>	No	2	
	(0)	a broken crown	Yes	<b>1</b>	No	2	
	(p)	a loose tooth	Yes		No	2	
	(q)	a cracked tooth	Yes	<b>1</b>	No	2	
	(r)	high temperature	Yes	<b>1</b>	No	2	
4	In th	ne last week, have you					
	(a)	chipped a tooth?	Yes		No	2	
	(b)	broken a tooth?	Yes		No	2	
	(c)	noticed any visible pink areas on the tooth as a result of a broken tooth?	Yes	1	No	2	
	(d)	broken or chipped a tooth as a result of an accident?	Yes	1	No	2	
15	In th teeti	he last week, have you experienced pain as a result h, mouth or dentures?	of problems	with your	Yes No	$ \square_1  \square_2 \longrightarrow \text{Go t}  Q15 continued on ne$	o Q1 ext pag

	<ul> <li>(a) If Yes, is this pain         <ul> <li>an ache?</li> <li>a throbbing pain?</li> <li>a dull pain?</li> <li>a sharp pain?</li> </ul> </li> </ul>		$ \begin{array}{c}     1 \\     2 \\     3 \\     4 \end{array} $
	a burning pain?		5
	a shooting pain?		6
	(b) Is this pain		
	constant?		
	intermittent?		
	increasing?		
	decreasing?		4
	(c) How long have you had this problem?		
	(d) Have you taken any medication to relieve this pain?	Yes No	$\Box_1 \longrightarrow \text{Go to (e), (f) \& (g)}$ $\Box_2 \longrightarrow \text{Go to Q16}$
	(e) If Yes, what medication have you taken?		
	(f) Please state the dosage used.		
	(g) How often did you use this medication to relieve pain	or discomfo	rt in your teeth or mouth?
	Once per day		
	Twice per day		
	Three to four times per day		
	Five to six times per day		
	Six or more times per day		5
16	What category best describes your teeth? (Please tick or	ne box)	
	Natural teeth only		$\Box_1 \longrightarrow Go to O18$
	Natural teeth and upper denture only		$\Box_2 \longrightarrow Go to Q17$
	Natural teeth and lower denture only		$\Box_3 \longrightarrow \text{Go to Q17}$
	Both upper and lower dentures with some nat	ural teeth	$\Box_4 \longrightarrow \text{Go to Q17}$

17	(a) How long ago did you receive your first denture(s)?	Upper denture	
		Lower denture	
	(b) How long have you had the denture(s) you wear now?	Upper denture	
		Lower denture	
18	(a) Have you ever had a tooth extracted?	Yes $\square_1 \longrightarrow$ Go to (b), (c) & ( No $\square_2 \longrightarrow$ Go to Q20	(d)
	(b) If Yes, why? (eg. wisdom tooth, decay, orthodontic etc)		
	(c) If Yes, how long has it been since your last extraction?		
	(d) How many teeth have you had extracted in the past 2 ye	ars? (Number)	
19	Have you had a tooth extracted in the last week?	Yes $\Box_1 \longrightarrow$ Go to (a) No $\Box_z \longrightarrow$ Co to Q20	
	(a) If Yes, have you experienced any bleeding?	Yes $\Box_1 \longrightarrow \text{Go to (b)}$ No $\Box_2 \longrightarrow \text{Go to Q20}$	
	(b) How often have you had to spit out blood? Very Often Fairly Often Sometimes Hardly ever Not at all	$ \begin{array}{c}                                     $	
20	What is your usual reason for visiting the dentist? For a regular check-up For an occasional check-up When in discomfort/pain When something needs to be fixed	$ \begin{array}{c}     1 \\     2 \\     3 \\     4 \end{array} $	
	7		

21	How long has it been since your last dental visit Less than 12 months $\Box_1$ 12 months to less than 2 years $\Box_2$ 2 years to less than 3 years $\Box_3$	(Please tick one box)         years to less than 5 years $\Box_4$ years or more $\Box_5$ lever $\Box_6 \longrightarrow$ Go to Q26
22	Where was your last dental visit? (Please tick of Private practice Public hospital/clinic School Dental Service Dental technician Health Fund Prison, corrective/detention institution Other Don't know	e box)
23	How often do you usually go to the dentist? (Plee More than 2 times a year $\Box_1$ Two times a year $\Box_2$ Once a year $\Box_3$	Ise tick one box)         Once every 2 years         Ince every 5 years         In
24	In which country was your last dental visit? ( <i>Ple</i> Australia Other ( <i>please specify</i> )	se tick one box)
25	What dental treatment did you receive at your la         None       1       Gu         Check-up       2       Tea         Dental filling       3       Ne         Amalgam replacement       4       Tea         Root canal filling       5       Wr         Crown       6       De         Tooth extracted       7       Ott	it dental visit/s? ( <i>Please tick one or more boxes</i> )

26	Do you think that dental treatments can help make your teeth and m	outh more	e healthy	? (Pleas	e tick on	e box)	)
	Probably/sometimes						
	No I 3						
	Don't know						
	For Q27 to Q29 please circle one number in each line to indicate the	e patient's	level of	agreeme	ent or		
	disagreement with each statement.						
27	During the last week, how often have pain, discomfort, or other problems with your teeth, mouth or dentures caused you to	All the time	Very often	Fairly often	Some- times	Ne	ver
	have difficulty sleeping?	1	2	3	4		5
	stay home more than usual?	1	2	3	4	ł	5
	stay in bed more than usual?	1	2	3	4	4	5
	take time off work?	1	2	3	4	5	N/
				Q27 a	ontinued c	n next	pag
		All the time	Very often	Fairly often	Some- times	Ne	ver
	be unable to do household chores?	1	2	3	4		5
	avoid your usual leisure activities?	1	2	3	4		5
28	During the last week, how often have you worried about	All the time	Very often	Fairly ofter	y Some times	9- N S	lever
	the appearance of your teeth or mouth?	1	2	3	4		5
	the health of your teeth or mouth?	1	2	3	4		5
29		Very Good	Good	Fair	Poor	r Y	Very poor
	How would you rate your general health?	1	2	3	4		5
	How would you rate your oral health?	1	2	3	4		5
'		-	-		-		

30	(a) Do you take any regular medication?Yes $\Box_1 \longrightarrow \text{Go to (b)}$ No $\Box_2 \longrightarrow \text{Go to Q31}$
	(b) Was this medication recommended by a health care provider? Yes 1 No 2
31	Imagine you had an appointment to go to the dentist tomorrow, how would you feel about it? (Please tick one bo
	I would look forward to it as a reasonably enjoyable experience
	I wouldn't care one way or the other
	I would be a little uneasy about it
	I would be afraid that it would be unpleasant and painful
	I would be very frightened of what the dentist might do
32	Imagine you are waiting in the dentist's waiting room for your turn in the chair, how would you feel? (Please tick one box)
	Relaxed
	A little uneasy
	Tense
	Anxious
	So anxious that I sometimes break out in a sweat or almost feel physically sick
33	Imagine you are in the chair waiting while the dentist gets the drill ready to begin working on your teeth, how would you feel? ( <i>Please tick one box</i> )
	Relaxed
	A little uneasy
	Tense
	Anxious
	So anxious that I sometimes break out in a sweat or almost feel physically sick
34	Imagine you are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist is gettir out the instruments to be used to scrape your teeth around the gums, how would you feel? (Please tick one box)
	Relaxed
	A little uneasy
	Tense
	Anxious
	So anxious that I sometimes break out in a sweat or almost feel physically sick

	How characteristic of you are the following statements? (Please circle one of the numbers in each line)							
		Uncharacteristic of me Characteristic of me						
ľ		very	rather	somewhat	somewhat	rather	very	
	I am quick to express an opinion when it comes to my dental health care needs.	1	2	3	4	5	6	
	I usually think my needs are not as important as other people's needs.	1	2	3	4	5	6	
	If treatment is not to my satisfaction, I let the dentist know I am not happy.	1	2	3	4	5	6	
	If the service received is not to my satisfaction, I complain to dental staff.	1	2	3	4	5	6	
86	Was this interview done by proxy?	Yes	□ <sub>1</sub> No	2				
	INTERVIEWER'S COMMENTS							
	Thank you for your co-operation	on and tin	ne in answe	ering this qu	uestionnaire	9.		
	Thank you for your co-operation	on and tin	ne in answe	ering this qu	uestionnaire	9.		
	Thank you for your co-operation	on and tin	ne in answe	ering this qu	iestionnaire	9.		
	Thank you for your co-operation	on and tin	ne in answe	ering this qu	uestionnaire	<u>a,</u>		
	Thank you for your co-operation	on and tin	ne in answe	ering this qu	uestionnaire	2,		
	Thank you for your co-operation	on and tin	ne in answe	ering this qu	uestionnaire	9.		
	Thank you for your co-operation	on and tin	ne in answe	ering this qu	iestionnaire	9.		
	Thank you for your co-operation	on and tin	ne in answe	ering this qu	iestionnaire	Ð.		

# Appendix B1: General model results using various cut-off values

#### General model 1

#### 1. cut-off = 0.2, sensitivity = 1.00, specificity = 0.004

		Clinician urç clinical assessmen)		
		≤6 months (+ve)	7+ months (-ve)	Total
Test result	≤6 months +ve	58	41 (FP)	99
(based on predictor variables)	7+ months -ve	0 (FN)	1	1
	Total	58	42	100

#### 2. cut-off = 0.4, sensitivity = 0.85, specificity = 0.46

		Clinician urg (clinical assessmen		
	-	≤6 months (+ve)	7+ months (-ve)	Total
Test result	≤6 months +ve	49	23 (FP)	72
(based on predictor variables)	7+ months -ve	9 (FN)	19	28
	Total	58	42	100

#### 3. cut-off = 0.5, sensitivity = 0.77, specificity = 0.63

		Clinician urç (clinical assessmen		
		≤6 months (+ve)	7+ months (-ve)	Total
Test result	≤6 months +ve	45	16 (FP)	61
(based on predictor variables)	7+ months -ve	13 (FN)	26	39
	Total	58	42	100

#### 4. cut-off = 0.57, sensitivity = 0.71, specificity = 0.73

		Clinician urç (clinical assessmen		
		≤6 months (+ve)	7+ months (-ve)	Total
Test result	≤6 months +ve	41	11 (FP)	52
(based on predictor variables)	7+ months -ve	17 (FN)	31	48
	Total	58	42	100

5.	cut-off = 0.6, sensitivity = 0.67, specificity = 0.76	
----	---	--

		Clinician urg (clinical assessmen	gency It of urgency)	
		≤6 months (+ve)	7+ months (-ve)	Total
Test result	≤6 months +ve	39	10 (FP)	49
(based on predictor variables)	7+ months -ve	19 (FN)	32	51
	Total	58	42	100

# 6. cut-off = 0.7, sensitivity = 0.51, specificity = 0.87

		Clinician urg (clinical assessmen	gency t of urgency)	
		≤6 months (+ve)	7+ months (-ve)	Total
Test result	≤6 months +ve	30	5 (FP)	35
(based on predictor variables)	7+ months -ve	28 (FN)	37	65
	Total	58	42	100

# 7. cut-off = 0.8, sensitivity = 0.34, specificity = 0.94

		Clinician urg (clinical assessmen	jency t of urgency)	
		≤6 months (+ve)	7+ months (-ve)	Total
Test result	≤6 months +ve	20	3 (FP)	23
(based on predictor variables)	7+ months -ve	38 (FN)	39	77
	Total	58	42	100

# 8. cut-off = 0.9, sensitivity = 0.15, specificity = 0.98

		Clinician urg (clinical assessmen	gency t of urgency)	
		≤6 months (+ve)	7+ months (-ve)	Total
Test result	≤6 months +ve	9	1 (FP)	10
(based on predictor variables)	7+ months -ve	49 (FN)	41	90
	Total	58	42	100

#### General model 2

		Clinician urg clinical assessmen)	gency It of urgency)	
		≤3 months (+ve)	4+ months (-ve)	Total
Test result	≤3 months +ve	40	58 (FP)	98
(based on predictor variables)	4+ months -ve	0 (FN)	2	2
	Total	40	60	100

# 1. cut-off = 0.1, sensitivity = 1.00, specificity = 0.03

# 2. cut-off = 0.2, sensitivity = 0.92, specificity = 0.32

		Clinician urg (clinical assessmen	jency t of urgency)	
		≤3 months (+ve)	4+ months (-ve)	Total
Test result	≤3 months +ve	37	41 (FP)	78
(based on predictor variables)	4+ months -ve	3 (FN)	19	22
	Total	40	60	100

# 3. cut-off = 0.3, sensitivity = 0.78, specificity = 0.58

		Clinician urç (clinical assessmen	gency t of urgency)	
		≤3 months (+ve)	4+ months (-ve)	Total
Test result	≤3 months +ve	31	25 (FP)	56
(based on predictor variables)	4+ months -ve	9 (FN)	35	44
	Total	40	60	100

# 4. cut-off = 0.4, sensitivity = 0.63, specificity = 0.74

		Clinician urg clinical assessmen)	gency t of urgency)	
		≤3 months (+ve)	4+ months (-ve)	Total
Test result	≤3 months +ve	25	16 (FP)	41
(based on predictor variables)	4+ months -ve	15 (FN)	44	59
	Total	40	60	100

# 5. cut-off = 0.5, sensitivity = 0.50, specificity = 0.85

		Clinician urç (clinical assessmen	gency t of urgency)	
		≤3 months (+ve)	4+ months (-ve)	Total
Test result	≤3 months +ve	20	9 (FP)	29
(based on predictor variables)	4+ months -ve	20 (FN)	51	71
	Total	40	60	100

6.	cut-off =	0.6, sen	sitivity	= 0.40, s	specificity	r = 0.92
----	-----------	----------	----------	-----------	-------------	----------

		Clinician urg (clinical assessmen	gency It of urgency)	
		≤3 months (+ve)	4+ months (-ve)	Total
Test result	≤3 months +ve	16	5 (FP)	21
(based on predictor variables)	4+ months -ve	24 (FN)	55	79
	Total	40	60	100

# 7. cut-off = 0.7, sensitivity = 0.27, specificity = 0.96

		Clinician urgency (clinical assessment of urgency)		
		≤3 months (+ve)	4+ months (-ve)	Total
Test result	≤3 months +ve	11	2 (FP)	13
(based on predictor variables)	4+ months -ve	29 (FN)	58	87
	Total	40	60	100

# 8. cut-off = 0.8, sensitivity = 0.16, specificity = 0.99

		Clinician urgency (clinical assessment of urgency)		
		≤3 months (+ve)	4+ months (-ve)	Total
Test result	≤3 months +ve	6	1 (FP)	7
(based on predictor variables)	4+ months -ve	34 (FN)	59	93
	Total	40	60	100

# 9. cut-off = 0.9, sensitivity = 0.05, specificity = 1.00

		Clinician urgency (clinical assessment of urgency)		
		≤3 months (+ve)	4+ months (-ve)	Total
	≤3 months +ve	2	0 (FP)	2
Test result (based on predictor variables)	4+ months -ve Total	38 (FN) <b>40</b>	60 <b>60</b>	98 <b>100</b>

# Appendix B2: Screening questions from general models

#### General model 1

These are the series of questions identified to assist in discriminating between those patients able to wait longer than 7+ months and those who should be seen within 6 months. Note that the responses given in the 'Response' boxes are only an example.

If a patient gave these responses to the questions it is predicted that they would require care within 6 months (based on a cut-off value of 0.5 – modifying the cut-off value may change the urgency prediction).

		Response
In the	last four weeks, have you had	
•	a toothache	Yes
•	pain in teeth with hot food or fluids	No
•	pain in teeth with cold food or fluids	Yes
	pain in teeth with sweet foods	No
	pain in jaw while chewing	Yes
•	pain in jaw when opening mouth wide	No
•	pain in front of ear	No
	burning sensation in tongue/mouth	No
	shooting pain in face or cheeks	No
•	pain or discomfort from denture	No
urin	g the past year…	
•	have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?	Never
	have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?	Never
•	have you had a painful aching in your mouth?	Hardly ever
•	have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?	Occasionally
•	have you been self conscious because of your teeth, mouth or dentures?	Never
	have you felt tense because of problems with your teeth, mouth or dentures?	Never
•	has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?	Never
•	have you had to interrupt meals because of problems with your teeth, mouth or dentures?	Never
•	have you found it difficult to relax because of problems with your teeth, mouth or dentures?	Never
•	have you been a bit embarrassed because of problems with your teeth, mouth or dentures?	Never
•	have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?	Never
•	<ul> <li>have you had difficulty doing your usual jobs because of problems with your teeth, mouth or dentures?</li> </ul>	Never
•	have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?	Never
•	have you been totally unable to function because of problems with your teeth, mouth or dentures?	Never
Vhat	is yoiur usual reason for visiting the dentist?	Check-up/Problem
low l	ong has it been since your last dental visit?	1-<3 years
## Appendix B3: General dental care questionnaire



	RESPONSES RECORDED MOST BE THOSE OF THE PATIENT.
1	Please indicate your date of birth:
2	Were you born in Australia? Yes 1 No 2
	If No, (a) in what country were you born?
	(b) in which year did you first arrive in Australia to live?
3	Are you of Aboriginal and/or Torres Strait Islander origin? No Yes, Aboriginal Yes, Torres Strait Islander 3
4	What is the postcode of the suburb/area you live in?
5	Which language do you <i>mainly</i> speak at home? ( <i>Please tick one box</i> )
	English 1 Mandarin 6
	Italian D Arabic D 7
	Greek
6	Australia's population is made up of many ethnic communities or groups.

_	
,	Which of the following best describes where you live? (Please tick one box)   House/flat/unit   Caravan   Caravan   Boarding house/hostel/refuge/rehabilitation   Group home   Institution   Aged care facility (incl. Nursing home, aged care hostel)   Retirement village   Other (please specify)
8	Which of the following best describes the household in which you live? (Please tick one box)   With spouse/partner only   With spouse/partner and child/ren   With parents   By self   With my child/ren only   Share with other adults   Other (please specify)
9	How old were you when you left school? (Please tick one box)   Did not go to school   14 years or younger   2   15 years   3   16 years   4   17 years   5   18 years   19 years or older
10	What is the highest level of education you have attained? (Please tick one box)         Primary School       1         Some secondary school       2         Completed secondary school       3         Some University, higher education       4         Completed a University, higher education course       5         Some TAFE, CAE or vocational course       6         Completed TAFE, CAE or vocational course       7         Other       8         Don't know       9

11	What is your usual/previous occupation?
12	(a) Do you have         Pensioner concession card (full entitlement)?       1         Pensioner concession card (part entitlement)?       2         Health care card?       3         Veterans Affairs Card?       4         Commonwealth Seniors Health Card?       5
	(b) How long have you had your concession card(s)?
	Commonwealth Seniors Health card
13	(a) Do you have private dental insurance?Yes $\Box_1 \longrightarrow \text{Go to (b)}$ No $\Box_2 \longrightarrow \text{Go to Q14}$
	(b) How long have you had private dental insurance?
	Less than 6 months $\Box_1$ 2 years to less than 3 years $\Box_4$ 6 months to less than 12 months $\Box_2$ 3 years to less than 5 years $\Box_5$ 1 year to less than 2 years $\Box_3$ 5 years or more $\Box_6$
14	Are you usually able to
	(a) chew a piece of fresh carrot? Yes 1 No 2
	(b) chew boiled vegetables? Yes 1 No 2
	(c) chew fresh lettuce salad? Yes 1 No 2
	(d) chew firm foods such as steaks or dried apricots? Yes $\Box_1$ No $\Box_2$
	(e) bite off and chew a piece of whole fresh apple? Yes $\Box_1$ No $\Box_2$
	An alter handling of the second
	(1) cnew hamburger? Yes 1 No 2

15	(a) I	How often do you add sugar to your food (eg. cereal, se	auces etc)	?							
	Never $\Box_1$ Rarely $\Box_2$ Sometimes $\Box_3$ Often/always $\Box_4$ How many teaspoons of sugar do you add to your food?										
	(b) How often do you add sugar to your drink <i>(eg. tea, coffee)</i> ? Never										
	Rarely $\begin{tabular}{lllllllllllllllllllllllllllllllllll$										
	(c) I	How many times did you have a dessert or sweet snacl	k yesterda	ıy?			]				
	(d)	How many times did you have a sweet drink vesterday	(on iuico	non diat se	off drink		7				
	(u) i	ea, coffee)?	(eg. juice,	, non-aiei sa	JIL GLITIK,						
16	Thir	nking about problems with your teeth or mouth.									
	(a)	do you ever have difficulty pronouncing any words?	Yes		No	$\square_2$					
	(b)	do you ever have difficulty speaking clearly?	Yes		No						
	(c)	do you ever have difficulty making yourself understood?	Yes		No						
17											
17	In th	teathcabe	s?		No						
	(a)	coornache	Yes		No						
	(D)	pain in teeth with hot foods or fluids	Yes		No						
	(c)	pain in teeth with cold foods or fluids	Yes		No						
	(d)	pain in teeth with sweet foods	Yes		No	<b></b> 2					
	(e)	pain in jaw while chewing	Yes		No						
	(f)	pain in jaw when opening mouth wide	Yes		No						
	(g)	pain which is worse in the middle of the day	Yes		No	2					
	(h)	pain at night	Yes		No						
	(i)	pain in front of ear	Yes		No						
	(j)	burning sensation in tongue or other parts of mouth	Yes		No						
	(k)	shooting pain in face or cheeks	Yes	1	No	2	_				
	(I)	pain or discomfort from denture	Yes	1	No	2	NA 🔲				

	(a) (b) (c) (d) (e) (f)	mouth ulcers cold sores sore gums bleeding gums	Yes Yes Yes		No	2	
	(b) (c) (d) (e) (f)	cold sores sore gums bleeding gums	Yes Yes		Ne		
	(c) (d) (e) (f)	sore gums bleeding gums	Yes	Π.	140	$\square_2$	
	(d) (e) (f)	bleeding gums			No	2	
	(e) (f)	<ul><li>(e) swelling on gums</li><li>(f) bad breath</li></ul>	Yes Yes Yes Yes Yes Yes Yes		No	2	
(	(f)				No	2	
(	(f) bad breath	bad breath		1	No	2	
	(g)	dryness of mouth		1	No	2	
(	(h)	unpleasant taste			No	2	
(	(i)	changes in ability to taste		1	No	2	
(	(i)	clicking/grating noise in jaw joint ) swelling of your face or neck		1	No	2	
(	(k)			1	No	2	
(	(I)	a lost filling	Yes	1	No	2	
(	(m) a (n) a	a lost crown	Yes Yes	1	No	2	
(		a broken filling		<b>1</b>	No	2	
(	(0)	a broken crown	Yes	1	No	2	
(	(p)	a loose tooth	Yes Yes	1	No No	2	
(	(q)	q) a chipped tooth				2	
(	(r)	a cracked tooth	Yes	1	No	2	
(	(s)	a broken tooth from an accident	Yes	1	No	2	
(	(t)	visible pink areas on the tooth as a result of a broken tooth	Yes		No	2	
(	(u)	high temperature	Yes	1	No	2	
19	Wha	at category best describes your teeth? (Please tick on	e box)				
		Natural teeth only Natural teeth and upper denture only Natural teeth and lower denture only Both upper and lower dentures with some natu	ural teeth	$ \begin{bmatrix} 1 \\ 2 \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \end{bmatrix} = \begin{bmatrix} 4 \\ 4 \end{bmatrix} = \begin{bmatrix} 4 \\ 4 \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \end{bmatrix} = \begin{bmatrix} 2$	$\rightarrow$	Go to Q21 Go to Q20 Go to Q20 Go to Q20	
20	(a) How long ago did you receive your first denture(s)?			er denture			
			Low	ver denture			$\overline{}$
						020 continued	
						web continued of	nexcpage

	(b) How long have you had the denture(s) you wear now? Upper denture Lower denture
21	What dental treatment do you think you currently need? (Please tick one or more boxes)
	None       I       Gum Treatment       Image: Barrier Barrie
22	(a) Have you ever had a tooth extracted? Yes $\Box_1 \longrightarrow$ Go to (b), (c) & (d) No $\Box_2 \longrightarrow$ Go to Q23
	(b) If Yes, why? (eg. wisdom tooth, decay, orthodontic etc)
	(c) How long has it been since your last extraction?
	(d) How many teeth have you had extracted in the past 2 years? (Number)
23	What is your usual reason for visiting the dentist?
	For a regular check-upIFor an occasional check-upIWhen in discomfort/painIWhen something needs to be fixedI
24	How long has it been since your last dental visit? (Please tick one box)
	Less than 12 months $\Box_1$ 3 years to less than 5 years $\Box_4$ 12 months to less than 2 years $\Box_2$ 5 years or more $\Box_5$ 2 years to less than 3 years $\Box_3$ Never $\Box_6 \rightarrow Go to Q29$

25	Where was your last dental visit? (Please tick one box)
	Private practice     1       Public hospital/clinic     2       School Dental Service     3
	Don't know
26	How often do you usually go to the dentist? (Please tick one box)
	More than 2 times a year 1 Once every 2 years
	Two times a year $\Box_2$ Once every 5 years $\Box_5$
	Once a year $\square_3$ Less often than that $\square_6$
27	In which country was your last dental visit? (Please tick one box)
	Australia
	Other (please specify)
28	What dental treatment did you receive at your last dental visit/s? (Please tick one or more boxes)
	Check-up Teeth straightened/braces
	Dental filling $\square_3$ New or replacement dentures $\square_{10}$
	Amalgam replacement
	Root canal filling 5 Whitening/bleaching 12
	Tooth extracted $\Box_6$ Dentate repair $\Box_{13}$
29	Do you think that dental treatments can help make your teeth and mouth more healthy? (Please tick one box)
	Yes/absolutely
	Probably/sometimes

30	Thinking about your dental health over the last year, how often	All the time	Very often	Fairly often	Some- times	-	Neve
	have you been prevented from eating foods you would like to eat?	1	2	3	4	╈	5
	have you found your enjoyment of food is less than it used to be?	1	2	3	4	T	5
	did it take you longer to finish a meal than other people?	1	2	3	4	╈	5
	have you found your taste for salt to have increased?	1	2	3	4	T	5
	did you avoid eating with other people because of problems with chewing?	1	2	3	4	T	5
	were you embarrassed by the appearance or health of your teeth or mouth?	1	2	3	4	T	5
	did you avoid laughing or smiling?	1	2	3	4	Τ	5
		1	1	1	1		
31	did you avoid conversation with others? During the past year, how often have pain, discomfort, or other problems with your teeth, mouth or dentures caused you to	1 All the time	2 Very often	3 Fairly often	4 Some- times	Ne	5 ever
31	did you avoid conversation with others? During the past year, how often have pain, discomfort, or other problems with your teeth, mouth or dentures caused you to have difficulty sleeping?	1 All the time 1	2 Very often 2	3 Fairly often 3	4 Some- times 4	Ne	5 ever 5
31	did you avoid conversation with others? During the past year, how often have pain, discomfort, or other problems with your teeth, mouth or dentures caused you to have difficulty sleeping? stay home more than usual?	All the time 1	2 Very often 2 2	Fairly often 3 3	Some- times 4 4	Ne	5 ∍ver 5
31	did you avoid conversation with others? During the past year, how often have pain, discomfort, or other problems with your teeth, mouth or dentures caused you to have difficulty sleeping? stay home more than usual? stay in bed more than usual?	All the time 1 1 1 1 1	2 Very often 2 2 2 2	Fairly often 3 3 3	Some- times 4 4 4	Ne	5 •ver 5 5 5
31	did you avoid conversation with others? During the past year, how often have pain, discomfort, or other problems with your teeth, mouth or dentures caused you to have difficulty sleeping? stay home more than usual? stay in bed more than usual? take time off work?	All the time 1 1 1 1 1 1 1	2 Very often 2 2 2 2 2 2	Fairly often 3 3 3 3 3	Some-times     4     4     4     4     4	Ne	5 5 5 5 N
31	did you avoid conversation with others? During the past year, how often have pain, discomfort, or other problems with your teeth, mouth or dentures caused you to have difficulty sleeping? stay home more than usual? stay in bed more than usual? take time off work? be unable to do household chores?	All the time111111	2 Very often 2 2 2 2 2 2 2 2 2	Fairly often 3 3 3 3 3 3	4 Some- times 4 4 4 4 4 4	Ne	5 5 5 5 5 5
31	did you avoid conversation with others? During the past year, how often have pain, discomfort, or other problems with your teeth, mouth or dentures caused you to have difficulty sleeping? stay home more than usual? stay in bed more than usual? take time off work? be unable to do household chores? avoid your usual leisure activities?	All the time111111111	2 Very often 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Fairly often 3 3 3 3 3 3 3 3 3	4 Some- times 4 4 4 4 4 4 4 4		5 5 5 5 5 5 5 5 5
31	did you avoid conversation with others?         During the past year, how often have pain, discomfort, or other problems with your teeth, mouth or dentures caused you to         have difficulty sleeping?         stay home more than usual?         stay in bed more than usual?         take time off work?         be unable to do household chores?         avoid your usual leisure activities?         During the past year, how often have you worried about	All the time 1 1 1 1 1 1 1 All the time	2 Very often 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Fairly often 3 3 3 3 3 3 5 airly often	4 Some- times 4 4 4 4 4 4 4 4 5 Some- times	5	5 5 5 5 5 5 8 8 8
31	did you avoid conversation with others?         During the past year, how often have pain, discomfort, or other problems with your teeth, mouth or dentures caused you to         have difficulty sleeping?         stay home more than usual?         stay in bed more than usual?         take time off work?         be unable to do household chores?         avoid your usual leisure activities?         During the past year, how often have you worried about         the appearance of your teeth or mouth?	1     All the time     1	2 Very often 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Fairly often 3 3 3 3 3 3 5 airly often 3	4 Some- times 4 4 4 4 4 4 4 4 5 Some- times 4	5	5 5 5 5 5 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8

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33	During the past year,	time	often	often	times	Never
	how often did you use medication to relieve pain or discomfort in your teeth or mouth?	1	2	3	4	5
34		Very Good	Good	Fair	Poor	Very Poor
	How would you rate your general health?	1	2	3	4	5
	How would you rate your oral health?	1	2	3	4	5
-						I
55	During the past year	Very often	Fairly often	Occas- ionally	Hardly ever	Neve
	have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?	1	2	3	4	5
	have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?	1	2	3	4	5
	have you had a painful aching in your mouth?	1	2	3	4	5
	have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?	1	2	3	4	5
	have you been self conscious because of your teeth, mouth or dentures?	1	2	3	4	5
	have you felt tense because of problems with your teeth, mouth or dentures?	1	2	3	4	5
	has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?	1	2	3	4	5
	have you had to interrupt meals because of problems with your teeth, mouth or dentures?	1	2	3	4	5
	have you found it difficult to relax because of problems with your teeth, mouth or dentures?	1	2	3	4	5
	have you been a bit embarrassed because of problems with your teeth, mouth or dentures?	1	2	3	4	5
	have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?	1	2	3	4	5
	have you had difficulty doing your usual jobs because of problems with your teeth, mouth or dentures?	1	2	3	4	5
	have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?	1	2	3	4	5
	have you been totally unable to function because of problems with your teeth, mouth or dentures?	1	2	3	4	5
						•

36	Have you sought medical care in the last 6 months?		res No	1 2	
37	(a) Do you take any regular medication?	, 1	res No		<ul> <li>→ Go to (b)</li> <li>→ Go to Q38</li> </ul>
	(b) Was this medication recommended by a health care provi	der?	Yes No		
38	Do you				
	(a) have diabetes?	, I	Yes No	1 2	
	(b) Do you smoke tobacco?	Yes No Occasionally	/	1 2 3	
39	Imagine you had an appointment to go to the dentist tomorrow I would look forward to it as a reasonably enjoyable ex I wouldn't care one way or the other I would be a little uneasy about it I would be afraid that it would be unpleasant and painful I would be very frightened of what the dentist might do	, how would perience ul	you f	eel about it	? (Please tick one box)
40	Imagine you are waiting in the dentist's waiting room for your to (Please tick one box) Relaxed A little uneasy Tense Anxious So anxious that I sometimes break out in a sweat or al	urn in the ch most feel ph	nair, ho nysica	ow would y	ou feel?
41	Imagine you are in the chair waiting while the dentist gets the of would you feel? ( <i>Please tick one box</i> ) Relaxed A little uneasy Tense Anxious So anxious that I sometimes break out in a sweat or all	drill ready to most feel ph	begir	n working o	n your teeth, how

	Imagine you are in the dentist's chair to have	your teeth	cleaned. W	hile you are	e waiting an	d the dentis	st is gettin			
	out the instruments to be used to scrape your teeth around the gums, now would you teel? (Please tick one box) Relaxed									
	Aprioup									
	So apvious that I comptimes break ou	t in a swoot	or almost f		ly cick					
	So anxious that I sometimes break ou	ii iii a sweai	or annost in	eei priysicai	IY SICK	5				
43	How characteristic of you are the following sta	atements? (/	Please circle	e one of the	numbers in	each line)				
		Unc	haracteristic	of me	Ch	aracteristic o	f me			
		very	rather	somewhat	somewhat	rather	very			
	I am quick to express an opinion when it comes to my dental health care needs.	1	2	3	4	5	6			
	I usually think my needs are not as important as other people's needs.	1	2	3	4	5	6			
	If treatment is not to my satisfaction, I let the dentist know I am not happy.	1	2	3	4	5	6			
	If the service received is not to my	1	2	3	4	5	6			
	eateraotion, roomplainte dentaretan.									
			YOY	6 I IA	1310					
	INTERVIEWER'S COMMENTS		re	s <u>1</u>		_2				
	INTERVIEWER'S COMMENTS		Te	s1		_2				
	INTERVIEWER'S COMMENTS			s [_]1						
				s1						
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	INTERVIEWER'S COMMENTS	ion and tim	e in answe	s1	uestionnair	 				

## Appendix C: Oral health data form



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		OHIME	000000000	00000000	00000000	0000000
SC	0-01	000 0000	00000000	000000000	00000000	0000000
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	1-4-	ARON KOJONH	000000000	00000000	000000000	00000000
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